NAVAL POSTGRADUATE SCHOOL

MONTEREY, CA

1991

OVERVIEW

The School

The Naval Postgraduate School is an academic institution whose emphasis is on study and research programs relevant to the Navy's interests, as well as to the interests of other arms of the Department of Defense. The programs are designed to accommodate the unique requirements of scheduling, sequencing and interfacing with the operational Navy.

The Campus

Located in Monterey, California, on the Pacific Ocean 120 miles south of San Francisco, the Naval Postgraduate School campus covers 627 acres of land. The site, which has been home to NPS since 1947, houses state-of-the-art laboratories, numerous academic buildings, a library, government housing and impressive recreational facilities.

The Students

Nearly 2,000 students attend the Naval Postgraduate School. The student body consists of officers from the five U.S. uniformed services, officers from approximately 25 allied countries and a small number of civilian employees. Selection of officers for fully funded graduate education is based upon outstanding professional performance as an officer, promotion potential and a strong academic background.

The Faculty

The faculty, the majority of whom are civilians, are drawn from a broad diversity of educational institutions and represent a prestigious collection of scholars. Faculty/student interaction is high. Every class is taught directly by a faculty member— over 99% of whom have a Ph.D.

The Degrees

The Naval Postgraduate School offers classes leading to advanced degrees in a variety of technical fields.

MASTER OF ARTS DEGREE: National Security Affairs

MASTER OF SCIENCE DEGREE: Aeronautical Engineering, Applied Mathematics, Astronautical Engineering, Computer Science, Electrical Engineering, Engineering Acoustics, Engineering Science, Hydrographic Science, Information Systems, Management, Mathematics, Mechanical Engineering, Meteorology, Meteorology and Physical Oceanography, Oceanography, National Security Affairs, Operations Research, Physical Oceanography, Physics, Systems Technology, Systems Engineering, Telecommunications Systems Management.

ENGINEER DEGREE: Aeronautical Engineer, Aeronautical and Astronautical Engineer, Electrical Engineer, Mechanical Engineer.

DOCTOR OF PHILOSOPHY: Aeronautical Engineering, Computer Science, Electrical and Computer Engineering, Engineering Acoustics, Mechanical Engineering, Meteorology, Operations Research, Physical Oceanography, Physics.

DOCTOR OF ENGINEERING: Aeronautical Engineering, Electrical and Computer Engineering, Mechanical Engineering.

For more information on admissions, or for a catalog, contact:

Director of Admissions
Code 62, Naval Postgraduate School,
Monterey, CA 93943-5000.
Telephone: (408) 646-3093 / AV 878-3093.

NAVAL POSTGRADUATE SCHOOL CATALOG

ACADEMIC YEAR 1991

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INTRODUCTION

Frank B. Kelso, II
Admiral, U.S. Navy
Chief of Naval Operations

CNO GRADUATE EDUCATION POLICY

> "Leadership and learning are indispensable to each other."
> -- President John F. Kennedy

Graduate education is both a noble idea, and an ongoing necessity that enhances the quality leadership essential for the United States Navy. I believe graduate education is one of the tools absolutely required for officers who will face growing complexities in technological, managerial and political/economic fields in the Navy. Even in this era of fiscal austerity and competing requirements placed upon our junior officers, investment in graduate education must be pursued as a priority.

The fully funded graduate education programs are intended for lieutenants and lieutenant commanders who have demonstrated superior professional performance and the intellectual capability to complete a rigorous academic program. These academic programs are designed to equip officers with enhanced intellectual and analytical capacity and make them more skillful warriors and specialists.

Graduates of the Naval Postgraduate School are applying the noble ideas they developed and learned on campus at Monterey throughout the Navy today. Because of our commitment to graduate education, today's naval officer corps is recognized as a leadership that sustains the finest Navy in the world with the power of knowledge, and the unique resilience to operate successfully in the harsh, unforgiving environments of advanced technology, politics and the ocean.

Frank B Kelso, II

Frank B. Kelso, II
Admiral, U.S. Navy

THE SCHOOL

To meet its educational requirements, the Navy has developed a unique academic institution at the Naval Postgraduate School (NPS) through the use of specially tailored academic programs, a distinctive organization and an uncommon tie-in between academic disciplines and naval applications.

The student body consists of U.S. officers from all branches of military service and international officers from allied countries. Selection of officers for fully funded graduate education is based upon outstanding professional performance as an officer, promotion potential and a strong academic background. Students receive graduate degrees as a result of successful completion of study programs designed primarily to prepare them for future career assignments; however, degrees are awarded on the basis of the same academic standards that prevail at other accredited institutions.

NPS is an academic institution whose emphasis is on study and research programs that are relevant to the Navy's interests, as well as the interests of other arms of the Department of Defense (DOD). The programs are designed to accommodate the unique requirements of scheduling, sequencing and interfacing with the operational Navy.

Superintendent
Ralph W. West, Jr.,
Rear Admiral, U.S. Navy

Provost & Academic Dean
Harrison Shull, Ph.D.

THE MISSION

The Naval Postgraduate School was established to serve the advanced educational needs of the Navy. The broad responsibility of the school is reflected in its stated mission:

> To conduct and direct the advanced education of commissioned officers, and to provide such other technical and professional instruction as may be prescribed to meet the needs of the Naval Service, and in support of the foregoing, to foster and encourage a program of research in order to sustain academic excellence.

The Secretary of the Navy has expanded upon this mission and has issued the following statement, which has been excerpted from SECNAV INSTRUCTION 1524, May 23, 1986:

> The Naval Postgraduate School exists for the sole purpose of increasing the combat effectiveness of the Navy and Marine Corps. It accomplishes this by providing post-baccalaureate degree programs in a variety of subspecialty areas not available through other educational institutions. NPS also supports the Department of Navy through the continuing programs of high-level naval and maritime research and through maintenance of operational commands, laboratories, systems commands and headquarters activities of the Navy and Marine Corps.

To fulfill its mission, the Naval Postgraduate School strives to sustain excellence in the quality of its instructional programs, to be responsive to technological change and innovation in the Navy, and to prepare officers to introduce and utilize future technologies.

ACCREDITATION

The Naval Postgraduate School is accredited by the Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges. Engineering curricula accredited by the Accrediting Board for Engineering and Technology (ABET) are Aeronautical, Electrical and Mechanical. The Administrative Sciences Curricula are accredited by the National Association of Schools of Public Affairs and Administration.

DEGREES CONFERRED

Although the curricula are tailored to address Navy requirements, they are developed within the framework of classical academic degrees, meeting the highest academic standards. Each curriculum leads to a master's degree; however, additional study can lead to either an engineer's degree or the doctor's degree.

Since its inception, over 16,000 graduate degrees have been awarded. The statistics for the past five academic years are:

	1984-85	**1985-86**	**1986-87**	**1987-88**	**1988-89**
MASTER'S	762	788	792	873	802
ENGINEER'S	13	21	25	19	21
DOCTOR'S	4	6	9	14	5
TOTAL	**779**	**815**	**826**	**906**	**828**

Rear Admiral John J. Donegan, Jr.
Commanding Officer, Naval Research Laboratory

Admiral John J. Donegan, Jr. is a 1972 graduate of the Naval Postgraduate School. Today, as Commanding Officer of the Naval Research Laboratory in Washington, D.C., he credits NPS for the practical training he received and continues his direct involvement with the school.

"As an Engineering Duty Officer, every tour since my 1972 graduation has required the application of my postgraduate training. Today, I am deeply involved with the Space Systems Engineering Curriculum and the Total Ship Systems Engineering program at NPS, and with the exchange of scientists from NRL with faculty and student experience tours from NPS."

Donegan stresses the important role the Naval Postgraduate School curriculum plays in today's Navy. "As Commanding Officer of the Navy's Corporate Research Laboratory, I have the opportunity to witness the advance of technology at the bench level. This work is conducted by skilled and dedicated scientists and engineers.

"The Navy will depend more on technology in the future than ever before. A quality postgraduate education and a firm grasp of the fundamentals are absolutely essential to the ability to lead in this environment."

DEGREES

MASTER OF ARTS DEGREES

National Security Affairs

MASTER OF SCIENCE DEGREES

Aeronautical Engineering
Applied Mathematics
Astronautical Engineering
Computer Science
Electrical Engineering
Engineering Acoustics
Engineering Science
Hydrographic Science
Information Systems
Management
Mathematics
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
National Security Affairs
Operations Research
Physical Oceanography
Physics
Systems Technology
Systems Engineering
Telecommunications Systems Management

ENGINEER DEGREES

(Typically requires one year of study beyond the Master's Degree)
Aeronautical Engineer
Aeronautical and Astronautical Engineer
Electrical Engineer
Mechanical Engineer

DOCTOR'S DEGREES

Doctor of Philosophy:
Aeronautical Engineering
Computer Science
Electrical and Computer Engineering
Engineering Acoustics
Mechanical Engineering
Meteorology
Operations Research
Physical Oceanography
Physics

Doctor of Engineering:
Aeronautical Engineering
Electrical and Computer Engineering
Mechanical Engineering

NAVAL POSTGRADUATE SCHOOL

The Naval Postgraduate School (NPS) is an opportunity you don't want to miss. Accepting only the best officers who have demonstrated through proven performance their strong drive for excellence, NPS is educating the leaders of tomorrow in the fields of science, engineering, operations analysis, management and national security affairs.

Excellence through education— that is the motto of NPS and it is proven time and again through the unparalleled education students receive during their stay at the school. Earning a degree from the Naval Postgraduate School is a strategic move for an officer looking to advance his or her career. Courses are structured so that officers build on their previous education and experience to develop both their operational and analytical skills while working with the latest technology. In our current volatile world, the ability to operate today's technology is not enough. Officers need to understand the fundamental elements of technology so that they are prepared for what the future has in store. NPS is preparing officer students for what the next generation, and generations beyond, will develop. NPS teaches the best how to stay one step ahead.

The facilities at the Naval Postgraduate School are top notch. Few universities can boast of better computer capabilities or research and instructional laboratories.

NPS's Computer Center supplies centrally managed computing services to all students and faculty. The Center provides users with consulting services, program libraries and languages, documentation, programming assistance, microcomputing support, system programming, procurement assistance and advice, and networking capabilities. In addition to the computers and computer support provided by the Center, all academic departments have clusters of microcomputers. Looking to the future, NPS is currently moving toward a computing environment in which powerful workstations are interconnected via a hierarchy of high-speed, local area networks.

The laboratories at NPS are also looking to the future. The Meteorology and Oceanography Department has created an Interactive Digital Environmental Analysis (IDEA) Laboratory, providing students with hands-on experience on equipment expected to appear in the fleet in 10 years. The IDEA Laboratory is the only modern digital analysis lab developed primarily for instruction in the United States.

The Naval Postgraduate School is also the only academic institution in the United States to own a communications satellite. NPS's Fleet Satellite Communications System is a qualification model identical to satellites currently in orbit. The satellite is used as a laboratory for space engineering and aeronautical engineering students and faculty studying satellite control systems, power systems, structural mechanics and ground control electronics.

The Warfare Analysis Research (WAR) Laboratory is another example of the unique technological environment at NPS. In the WAR Lab students and faculty members receive hands-on experience through

Lieutenant Commander Craig H. Cowen fought hard for the opportunity to attend the Naval Postgraduate School, and he's glad he did. Cowen, who will soon receive his Master of Science in Operations Research, knows his education will help him in the future.

"It's definitely a career plus to have a master's degree, especially a technical degree, and NPS is one of the top institutes in the United States in which you can receive an advanced degree in Operations Research."

Cowen's thesis, entitled "Identification of Delta-K Parameters Using Classification and Regression Trees," involves developing a methodology for analyzing radar waveforms that can identify aircraft types. In addition to the scientific information he has learned through his thesis research, Cowen has also learned how to better manage and work through problems that, at times, seem insolvable.

"My education at NPS has taught me to think analytically. Now, instead of using the standard 'cookbook approach' to solving problems and searching for the 'magic answer,' I'm able to take a step back and approach the problem from a new angle."

Cowen will be putting his degree and new-found knowledge to the test during his next job as Executive Officer on the USS Harry E. Yarnell (CG-17), a Leahy class guided missile cruiser.

simulated training in the tactical employment of weapons systems. The lab is also used for numerous research purposes, including studying how wargaming can improve the decision making process. The WAR lab is just one sample of the state-of-the-art technology available at NPS. Only one other school in the world, the Naval War College, has a facility that is even comparable.

In addition to its technological superiority, the preeminence of the Naval Postgraduate School is founded upon the world-renowned scientists and engineers who teach officers here. At NPS, all faculty members play an *active* role in the development of their students. *Every* class is taught directly by a faculty member, over 99% of whom have Ph.D.'s. The majority of the faculty are civilians, all of whom have excelled in their respective fields before coming to NPS. The faculty is attracted to the school by the superior facilities, high caliber students, excellent resources for teaching and research, and the surrounding environment.

A degree from the Naval Postgraduate School is an accomplishment earned with pride. Graduates from NPS join the ranks of some very successful people, many of whom are now flag officers. An impressive 47% of all admirals graduated from NPS-sponsored programs. While many factors led to the success of these people, the education they received at the NPS certainly contributed to making them highly competitive in every assignment.

NPS is committed to providing students with the best learning environment and facility support available. Construction has begun on additions to the existing library and a new academic building. The library expansion will increase the current facility by 80% — adding room for more shelving space, conference rooms and better study areas. The new academic building will house the National Security Affairs, Mathematics, and Operations Research Departments,

Turgut Sarpkaya
Distinguished Professor, Mechanical Engineering

For Distinguished Professor Turgut Sarpkaya, who has been at NPS for 23 years, it's the combination of experienced students, the intimate size of classes and the support for research that makes for an excellent educational environment. "Our students come here with prior college education and experience in the Navy, and in life. They have an employer; they are responsible. When they come here, with whatever rank they may have, they have one objective: to be promoted to the higher and more noble rank of student. Once they are promoted to that rank, they know that their job is to do the homework and learn as much as they can because, for most of them, this will probably be their last graduate education."

Referring to his own area of research, hydrodynamics, Sarpkaya says, "The students are my colleagues, my partners. I don't regard them as students and I ask them not to regard me as their boss or professor. We're here to work together. And our Master of Science thesis is unique. Students have the opportunity to do something for the first time, think something no one has ever thought, or writtten, or said before."

That uniqueness is reflected not only in the thesis, but in the man, his research and the institution as a whole. "The Naval Postgraduate School has been #1 in many research areas, and hydrodynamics is one of them," he explains. "In the area of nonacoustic detection of submarines and the area of wave forces on submerged bodies — particularly on vortex breakdown — we have done things that no man has ever done before. We are fortunate, and I am grateful, for the support of the Navy."

providing new classroom and laboratory space. Other future facility expansions are currently in the formative stage.

To ensure that they remain on the leading-edge of technology in a rapidly changing world, the courses at the Naval Postgraduate School are in an ongoing review process. The school's primary purpose is to provide academic programs that are relevant to the Navy's interests. As those interests change, so will NPS.

While the military is expected to decrease in size in upcoming years, it is anticipated that the need for postgraduate education will increase. In light of personnel reductions, a greater percentage of officers will need advanced education in technical fields. The military will need this "richer mix" of highly educated individuals in order to perform with fewer numbers. The Naval Postgraduate School will undoubtedly play a key role in fulfilling these advanced education needs.

As the United States prepares for the 21st century, the Naval Postgraduate School plays a strategic role in training officers of all services for leadership responsibilities. NPS is a joint school which provides officers with the opportunity to expand their intellectual capabilities and develop analytical skills early in their careers. Students who capitalize on this opportunity will be the guiding forces of future military operations and development. It is these students who will have the vision to bring new technologies to the operating forces, who will have the fundamental skills and understanding to act appropriately in combat situations, and who will lead the U.S. Navy successfully into the 21st century. As Navy Secretary H. Lawrence Garrett III affirms, NPS is "the front line of the future."

SCHOOL STRUCTURE AND ORGANIZATION

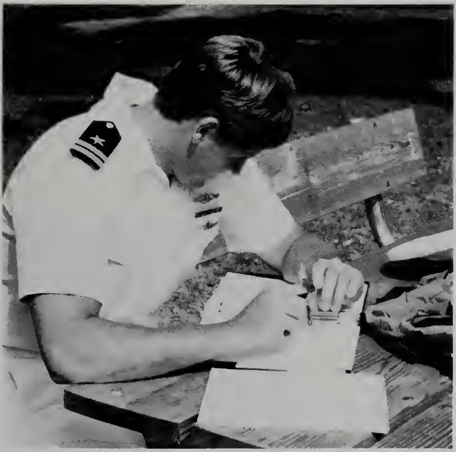
The Naval Postgraduate School was established and is funded by the Congress of the United States. It is administered as an activity within the Department of the Navy. The institution's governance and administration follow norms for civilian higher education, adapted appropriately for the Navy's specialized needs.

GRADUATE EDUCATION REVIEW BOARD

A Graduate Education Review Board, chaired by the Chief of Naval Operations and including the Vice Chief of Naval Operations, the Deputy Chief of Naval Operations (Manpower, Personnel and Training, OP-01), the Superintendent, Naval Postgraduate School and a representative from the Naval Systems Command (on a rotating basis) meets annually to provide policy guidance and direction for the Navy's graduate education program. The Board reviews the adequacy and stability of resources and student input. Prior to this meeting, a separate Graduate Education Review Group, chaired by the Vice Chief of Naval Operations, meets to review graduate education issues and identify matters of potential interest to the Graduate Education Review Board. The Graduate Education Review Group membership includes the principal warfare sponsors, principal subspecialty primary consultants and the Superintendent, Naval Postgraduate School.

BOARD OF ADVISORS

The Board of Advisors is composed of distinguished professionals, consisting of highly qualified civilian educators, prominent citizens from business, the professions and other vocations, and active and retired military officers. The purpose of the Board is to assist the Superintendent on strategic matters of the Navy's Graduate Education Programs and advise the Secretary of the Navy of their needs. In fulfilling this objective, the Board assesses the effectiveness with which the Naval Postgraduate School is accomplishing its mission and evaluates its future plans. Board members are appointed for two terms of two years by the Secretary of the Navy upon the recommendation of the Superintendent. Each appointment is renewable once for a second period of two years.



The Board meets annually at the Naval Postgraduate School and submits a report of its recommendations to the Secretary of the Navy via the Superintendent. Board members also serve on departmental academic review committees during the year and assist in other matters as requested by the Superintendent or the Secretary of the Navy.

ADMINISTRATION

The Superintendent of the Postgraduate School is a flag officer of the line of the Navy. His principal assistant is the Provost/ Academic Dean, who is ranking member of the civilian faculty.

The Superintendent has command responsibility for accomplishment of the school's mission. The Provost/Academic Dean is the chief educational officer and is responsible to the Superintendent for all academic matters. He is appointed by the Secretary of the Navy upon the recommendation of a council of NPS senior personnel, chaired by the Superintendent.

In addition to serving as the institution's president, the Superintendent is the academic coordinator for all graduate education programs in the Navy. He administers fully funded graduate educational programs at the Naval Postgraduate School, other service graduate schools and civilian universities.

ADMINISTRATIVE STAFF

Principal assistants to the Superintendent and Provost are two captains of the line and three civilian deans. The military positions are Dean of Students/Director of Programs and Director of Military Operations. The academic positions are Dean of Faculty and Graduate Studies, Dean of Research and Dean of Instruction. These positions are currently held by:

DEAN OF STUDENTS/DIRECTOR OF PROGRAMS
Hillar Sarepera,
Captain, U.S. Navy

DIRECTOR OF MILITARY OPERATIONS
John C. Cook, Jr.,
Captain, U.S. Navy

DEAN OF FACULTY AND GRADUATE STUDIES
Gordon E. Schacher,
Professor of Physics

DEAN OF RESEARCH
Paul Marto,
Distinguished Professor
of Mechanical Engineering

DEAN OF INSTRUCTION
Richard S. Elster,
Professor of Administrative Sciences

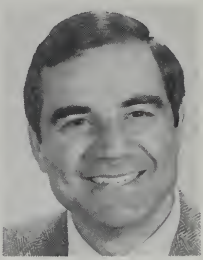
Dean of Students/
Director of Programs
Hillar Sarepera,
Captain, U.S. Navy

Director of Military
Operations
John C. Cook, Jr.,
Captain, U.S. Navy

Dean of Faculty and
Graduate Studies
Gordon E. Schacher,
Professor of Physics

ACADEMIC DEPARTMENTS AND GROUPS

Members of the faculty are organized into eleven Academic Departments and four interdisciplinary Academic Groups. Each is supervised by a chairman who reports to the Dean of Faculty and Graduate Studies. Over 90% of the teaching staff are civilians of varying professional rank and the remainder are military officers.



Dean of Research
Paul Marto,
Distinguished Professor
of Mechanical Engineering

ACADEMIC DEPARTMENTS

- Administrative Sciences
- Aeronautics and Astronautics
- Computer Science
- Electrical and Computer Engineering
- Mathematics
- Mechanical Engineering
- Meteorology
- National Security Affairs
- Oceanography
- Operations Research
- Physics

ACADEMIC GROUPS

- Antisubmarine Warfare
- Command, Control and Communications
- Electronic Warfare
- Space Systems

Dean of Instruction
Richard S. Elster,
Professor of
Administrative Sciences

CURRICULAR OFFICES

The Curricular Offices are organizational entities that are separate from, but interactive with, the Academic Departments in the educational operations of the school. The former are staffed by naval officers and civilian faculty members whose primary functions are threefold: (1) academic counseling and military supervision of officer

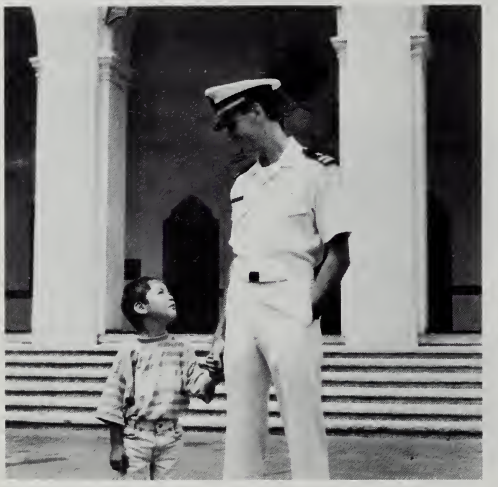
student, (2) curriculum development and management to ensure attainment of professional and academic objectives, and (3) liaison with curricular sponsor representatives.

Students are grouped in accordance with their curricular programs and are assigned to one of eleven Curricular Offices for program supervision and for academic and professional counseling.

Students in each curricular group pursue similar or closely related curricula. Each Curricular Office is staffed by one or more military officers of suitable experience and rank and one or more Academic Associates. The latter are faculty members selected for this part-time assignment. They are responsible to the Deans for the integrity and academic soundness of the academic features of the Curricular Office operations. Curricular Officers ensure their curricula meet Navy needs and ensure the proper administrative operation of their respective offices. They report to the Director of Programs.

Officer students are grouped into the following curricular program areas:

Administrative Sciences
Aeronautical Engineering
Air-Ocean Sciences
Antisubmarine Warfare/Electronic Warfare
Computer Technology
Electronics and Communications
Joint Command, Control and Communications (C3) and Space Systems
National Security Affairs and Intelligence
Naval Engineering
Operations Analysis
Weapons Systems Engineering



FACULTY ORGANIZATIONS

The faculty plays a role in school-wide policy making and planning through various established Councils. The Faculty Council functions as a primary faculty input advisory vehicle to the Provost and Superintendent. The Academic Council, a representative body of each academic department and group, has cognizance over all academic standards and degree-granting considerations. The composition of each Council and its specific functions are described in the NPS Organization and Regulations Manual.

While working towards her Master of Science in Computer Science, **Captain Rosemary Stewart** of the U.S. Army is also actively involved in student affairs as a representative to both the Officer Student Advisory Council and the Library Council. Through her positions on these councils, Stewart acts as a liaison between other students and the administration. "The Student Council is an excellent avenue for communicating with the administration. I act as the voice of the students in my curriculum. Being on these councils is alot of fun; it gives me a chance to meet people outside my curriculum."

Stewart truly appreciates the value of the education she is receiving at NPS. "The way I look at it, any education is a great education. At the Naval Postgraduate School this is especially true. Here I get to interact with several top-notch instructors and students. Last year I attended a class taught by Professor Richard Hamming, who invented the Hamming Code back in the 1950's. Some of the people here are really impressive.

"At NPS you also learn quite a bit from the other services and our allies. You learn how they work and how to work with them, which is really important for joint operations."

STUDENT COUNCIL

The Officer Student Advisory Council (OSAC) is an organized communication mechanism between the NPS students and the NPS administration. It functions in an advisory capacity in matters involving curricula, facilities, procedures and policies deemed worthy of attention. The OSAC is comprised of thirty-five student representatives and membership is distributed among the curricula by student population, with each curriculum having at least one representative.

The OSAC is headed by a Chairman, Vice Chairman and Secretary elected by members of the Student Council. Officers serve for a six-month period.

Besides a Steering Committee and an Election Committee, Student Council committees are formed to correspond with those NPS committees or councils which have an impact or effect on the student body and which can give or receive benefit from such representation. OSAC representation is included in the following NPS standing Councils and Committees:

Academic Council
Faculty Council
Library Council
Exchange/Bookstore Committee

ADMISSIONS

U.S. Navy officers interested in attending one of the curricula offered at the Naval Postgraduate School are referred to OPNAVINST 1520.23 and to the latest OPNAVNOTE 1520. These documents provide guidance, information and policy for the Navy's fully funded graduate education program.

SELECTION PROCEDURES

NAVAL OFFICERS

Selection for the Navy fully funded graduate education program is based on outstanding professional performance, promotion potential and a strong academic background. Unrestricted Line officers being considered by statutory selection boards for promotion to Lieutenant or Lieutenant Commander are eligible for selection for fully funded graduate education. Restricted Line and Staff Corps eligibility information is available through community newsletters or directly from assignment officers. Boards will select groups of officers considered to be professionally qualified; upon determination of academic qualification (by NAVPSGCOL), individuals are eligible for assignment. Officers who are professionally qualified but lack academic qualifications should contact the Director of Admissions for information on ways to improve their academic background. Once selected, officers will be notified by COMNAVMILPERSCOM notice.

OTHER U.S. MILITARY OFFICERS

Officers on duty with other branches of service are eligible to attend the Postgraduate School. Requests for admission or transcripts from individual officers should not be sent directly to the Naval Postgraduate School. They should apply in accordance with the directives promulgated by the Department of the Army, Department of the Air Force, Commandant U.S. Marine Corps or the Commandant U.S. Coast Guard, as appropriate.

ALLIED COUNTRY MILITARY OFFICERS

Military officers from allied countries may be admitted to most curricula. Their admission is subject to availability of quotas assigned to each country. The procedures for application are contained in OPNAV INSTRUCTION 4950.1E. Correspondence must be processed through normal channels; requests from individual officers should not be sent directly to the Naval Postgraduate School. In addition to fluency in English, candidates must satisfy the academic standards for each curriculum as described in this catalog.

CIVILIAN EMPLOYEES OF U.S. GOVERNMENT

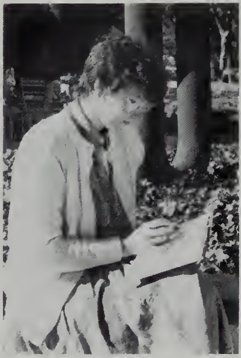
A civilian employee of an agency of the United States Federal Government may be admitted for study upon request and sponsorship of the agency. Federal civilian employees are not required to pursue the curricula designed for officer-students as described in this catalog but instead determine, with the guidance of assigned academic counselors, the combination of courses that will best meet their needs.

A civilian who is expecting agency sponsorship should submit a written request for evaluation for admission at least six months prior to expected commencement of studies. A request should indicate the desired curriculum and degree intentions and be accompanied by a complete set of official transcripts of all previous college work. GRE and/or GMAT scores are not required but will be considered when included in the submission.

Requests for admission should be directed to the Director of Admissions, Code 62, Naval Postgraduate School, Monterey, CA 93943-5000. Questions about available programs or admission procedures may be telephoned to (408) 646-3093 or Autovon 878-3093.

Any civilian employee of the United States Government is eligible to participate in the program of the School. The individual's employing agency is expected to meet the tuition expense for regular on-campus enrollment.

Programs available to civilian students can be classified as follows:



Regular Curricula: The school's programs for officers are designed to meet the requirements of the services for specific education. The contents usually exceed the requirements for a graduate degree since the service's requirements, rather than degree requirements, determine the scope of each program. Civilian students may enter any curriculum at the point at which they are qualified and complete the curriculum along with regular officer students. The programs section describes the available curricula.

Degree Programs: For civilian students, programs may be designed which lead to the award of a graduate degree while meeting the educational goals of each individual. In order to minimize the residency requirement, an off-campus preparatory program may be developed in consultation with a school advisor. If the available time in residence, typically four calendar quarters, is insufficient to complete degree requirements, the thesis-project portion of the program may be completed off-campus.

Non-Degree Programs: Civilian employees may desire to pursue a program for professional advancement without a degree objective. Any of the school's regular courses are available for such efforts. For groups of employees from an agency, special courses can be offered to meet particular requirements, provided the demand is in an area of expertise of the school.

Admission: For admission to either a degree or a non-degree program, the minimum qualification is an accredited baccalaureate degree with appropriate preparation for the proposed program. The school will require submission of official transcripts covering all college work completed to date.

CATALOGS

The point of contact for requests for Naval Postgraduate School Catalogs and admission to resident study programs is:

Director of Admissions, Code 62
Naval Postgraduate School, Monterey, CA 93943-5000
Telephone (408) 646-3093, Autovon 878-3093

ACADEMIC PROFILE CODES

The Academic Profile Code (APC) is a three-digit code which summarizes pertinent portions of an officer's prior college performance. The Naval Postgraduate School routinely generates APCs for officers of most Navy communities, usually within three years of commissioning. The three independent digits reflect an individual's cumulative grade-point average (QPR), exposure to and performance in calculus-related mathematics courses and exposure to and performance in selected science/engineering areas.

First Digit

The first digit indicates overall academic performance and is derived from the following table:

Code	QPR Range
0	3.60-4.00
1	3.20-3.59
2	2.60-3.19
3	2.20-2.59
4	1.90-2.19
5	0 -1.89

(Failures and repeated courses are included in the QPR calculation.)

Second Digit

The second digit represents mathematical background according to the following criterion:

Code	Meaning
0	Significant post-calculus math with B or better average
1	Calculus sequence completed with B+ or better average
2	Calculus sequence completed with average between C+ and B
3	One calculus course with C or better
4	Two or more pre-calculus courses with B or better average
5	One pre-calculus with C or better grade
6	No college level calculus or pre-calculus math with a grade of C or better

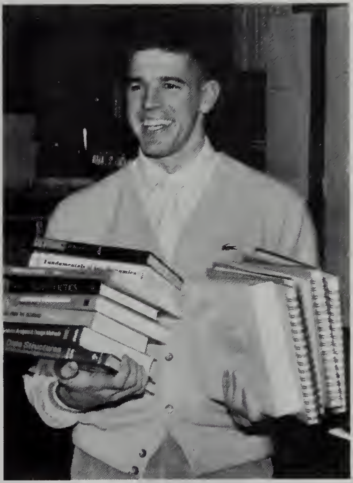
NEW ARRIVALS

Third Digit
The third digit represents previous course coverage in science and technical fields:

Code	Meaning
0	Significant pertinent upper-division technical courses with B+ or better average
1	Significant pertinent upper-division technical courses average between C+ and B
2	Complete calculus-based physics sequence with B+ or better average
3	Complete calculus-based physics sequence with average between C+ and B
4	One calculus-based physics course with C or better grade
5	No pertinent technical courses

A first digit code of 0, 1, 2, or 3 (as appropriate) will be assigned only if transcripts provided exhibit at least one hundred semester hours or one hundred fifty quarter hours of actual graded classroom instruction. Grades of Pass/Fail, Credit/No Credit will not count toward the 100/150 hour requirement.

A technical code of 1 or 0 ordinarily is assigned only to an officer whose undergraduate major was Physics, Aeronautical, Electrical, Mechanical or Naval Engineering, or whose undergraduate technical major is consistent with the officer's designator.



Example
An APC of 221 indicates a total grade average for all college courses in the interval 2.60-3.19, a complete sequence in calculus-of-one-variable with a C+ or B average and a major in physics or pertinent engineering area with upper-division courses with a C+ or B average.

Threshold
Each curriculum at the Naval Postgraduate School has a specified threshold APC for admission. A list of these is given at the beginning of the section on programs. Officers with deficient APCs may qualify for entry into these curricula by completing suitable courses at any accredited civilian college. Transcripts (not grade reports) of work done at civilian schools must be forwarded to the Director of Admissions, Code 62, Naval Postgraduate School, Monterey, CA 93943-5000, to effect an APC change. The grades in all courses completed will be used to revise an officer's QPR.

COURSE CODES

Courses are designated by an alpha-numeric symbol consisting of two letters and four numbers. The first two letters designate the academic department which offers the course and are defined as follows:

Administrative Sciences	AS
Service Courses	
Telecommunications Systems Management	CM
Information Systems	IS
Management	MN
Aeronautics and Astronautics	AE
Antisubmarine Warfare	ST
Command, Control and Communications	CC
Computer Science	CS
Electrical and Computer Engineering	EC
Electronic Warfare	EW
Interdisciplinary Courses	EO
Mathematics	MA
Mechanical Engineering	ME
Materials Science	MS
Meteorology	MR
National Security Affairs	NS
Oceanography	
Oceanographic Sciences	OC
Hydrographic Sciences	GH
Operations Research	
Operations Analysis	OA
Service Courses	OS
Physics	PH
Science and Engineering	SE
Space Systems	SS

Courses are assigned numbers in accordance with their level of academic credit:

0001-0999	No credit
1000-1999	Lower division college credit (Freshman - Sophomore Level)
2000-2999	Upper division college credit (Junior - Senior level)
3000-3999	Upper division college or graduate credit
4000-4999	Graduate credit

Following the course designator are two numbers in parentheses separated by a hyphen which indicate the hours of instruction per week in the classroom and in the laboratory, respectively. Laboratory hours are assigned half the value shown in calculating quarter hours for the credit value of the course. Thus a (3-2) course, having three hours lecture and two hours laboratory, will be assigned a credit value of four quarter hours.

GRADING

Student academic performance is evaluated in terms of quality points assigned to the letter grade achieved in a course. Based on the level of achievement associated with each letter grade, the corresponding quality point values range from a maximum of 4 to a minimum of 0 as follows:

Grade	Point Value
A	4
A-	3.7
B+	3.3
B	3
B-	2.7
C+	2.3
C	2
C-	1.7
D+	1.3
D	1
X	0

Letter designations for which no quality points are assigned are given as follows:

I	Incomplete
W	Withdrew
N	Ungraded
P	Pass
F	Fail

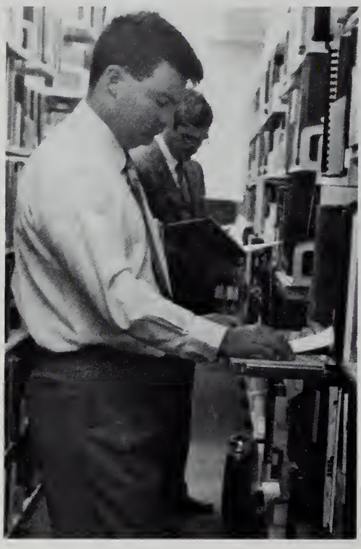
The grade of Incomplete is given when an identifiable portion of the course remains undone at the end of the quarter. One additional quarter is granted to submit the delinquent work. If the “I” is not removed within the twelve weeks following the end of the term in which it was assigned, it becomes an “X.”

A student may withdraw from a course up to the end of the second week of the quarter without any record of it showing on the transcript. Withdrawals may be made after that up to the end of the eighth week of the quarter, but a grade of “W” is entered for the course on the transcript. No withdrawals can be made after the eighth week.

Courses may be designated for “P” and “F” grading when approved by the Academic Department and the Academic Council. A student in a degree program who wishes to take courses not in his or her normal program may elect to take them in the Pass/Fail mode. Approval must be granted by the student’s cognizant Curricular Officer and Department Chairman. It is the responsibility of the student to exercise the P/F option by informing the instructor in writing at the time of enrollment that a P/F grade is desired. A copy of the approved request shall be forwarded to the Registrar. Students electing to receive the P/F grade in letter graded courses may not apply the hours toward the degree and curriculum requirements of any program.

QUALITY POINT RATING (QPR)

When the quarter-hour credit of a course is multiplied by the point value of the student's grade, a quality point value for the student's work in the course is obtained. The sum of the quality points for all courses divided by the sum of the quarter-hour credit of these courses gives a weighted numerical evaluation of the student's performance, termed the Quality Point Rating (QPR). A student achieving a QPR of 3.0 has maintained a "B" average in all courses undertaken with a proper weight assigned for course hours.



ACADEMIC COUNSELING

The NAVPGSCOL provides academic counseling services as indicated below to assist officers in developing individual educational plans. Officers who have chosen specific curricula or who have been selected or detailed for graduate education in programs at NAVPGSCOL, are advised to contact the appropriate NAVPGSCOL curricular office listed in the Programs Section of this catalog. Officers not yet selected for graduate education and seeking general information about the curricula offered at the school, or for general information on the fully-funded graduate education selection process, are advised to contact the Director of Admissions (Code 62), NAVPGSCOL, or telephone (408) 646-3093, AV 878-3093.

COURSE REGISTRATION AND CREDIT

Each student must be registered in each course in which he/she is a candidate for credit not later than the end of the second week of the term. No student will receive credit for a course unless registration in that course has been approved by one of the following: the student's Curricular Officer or Academic Associate, the Chairman of his/her doctoral committee, or the Dean of Instruction.

Overload: A student may not enroll for more than 21 total credit hours or more than four 3000 and/or 4000 courses (excluding laboratories or explicit curriculum requirements) per quarter unless he or she has either a total QPR of at least 3.50 or permission of the Department or Group Chairman and the Dean of Instruction.

Repetition of Courses: A student may repeat a course for the purpose of improving a grade when the grade received originally was either D or X, provided such course repetition is taken at the Postgraduate School. Approval must be granted by both the Curricular Officer and the Department Chairman concerned and the Registrar is to be notified.

For record purposes, both the original and the repeated courses are to be shown on the transcript. For Quality Point Rating computation, the credit hours of the course shall be counted once with the quality points earned being the average of the two.

Medical Absence: The academic record of a student may be deleted completely for a given term when the student is absent for a portion of the term for medical reasons. The transcript will show, "Excused for the term for medical reasons." The student shall not be permitted to delete only a portion of the courses for this reason. The grade "W" shall be used when it is necessary to withdraw from only a part of the student's program. Such excusals shall be requested by the Curricular Officer and approved by the Dean of Instruction.

Credit by Examination: The award of credit solely on the basis of examination for any 1000 or 2000 level course is permissible. Grades for such courses shall be awarded on a Pass/Fail basis.

VALIDATION

A student with the appropriate background may validate a course that is required for his/her curriculum. Validation will allow the student to omit that course from the program of study; however, no credit will be granted for a course that has been validated. The basic purpose of course validation is to make optimal use of the student's time at the Naval Postgraduate School. Every validation must be justified by documented evidence of prior work in the area of the course to be validated.

The validation of a course must be approved in writing by the Chairman of the department offering the course or a designated representative. Specific criteria for validation (e.g., review of the student's transcripts or examination on the material of the course) are left to the discretion of the cognizant Department Chairman.

After validating one or more courses, it may be possible for a student to complete the program in less than the maximum time allowed.

TRANSFER OF CREDITS

Upon entry to the Naval Postgraduate School, each student's academic record will be evaluated for possible transfer of credit or for exemption from portions of the curricular program by validation of course work previously completed. Students may also utilize knowledge gained through self-study, experience of service-related education to seek validation, or credit for curricular courses by taking a departmental examination.

Twelve hours of graduate-level courses previously completed may be accepted for transfer credit. These include graduate-level courses taken after completion of the baccalaureate degree and those taken in the last term before award of the baccalaureate and certified to be in excess of degree requirements.

Questions on transfer credit should be directed by letter to the appropriate curricular Academic Associate, as listed in this catalog.

DUAL DEGREE PROGRAMS

Students who wish to pursue a dual degree program must satisfy QPR and other curricular/departmental requirements, as set forth in the Academic Council Policy Manual.

TRANSPORTATION LOGISTICS MANAGEMENT CURRICULUM 813

This curriculum is an interdisciplinary program which integrates mathematics, accounting, economics, behavioral science, management theory, operations/systems analysis and a subspecialty concentration into an understanding of the process by which the defense mission is accomplished. These programs are designed to provide the officer with fundamental interdisciplinary techniques of quantitative problem-solving methods, behavioral and management science, economic analysis, and financial management; furthermore, it is intended to provide the officer with a Navy/Defense Systems-oriented graduate management education and to provide the officer with the specific functional skills required to effectively manage in this subspecialty area.

Curricular Officer:
Dennis G. Allion,
CDR, SC, USN,
Code 36, Ingersoll Hall,
Room 219,
(408) 646-2536, AV 878-2536.

REQUIREMENTS FOR ENTRY

A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered to be the minimum mathematical preparation. An APC of 345 is required for entry.

Officers from the U.S. Services, as well as all others, start the curriculum with widely varied academic backgrounds. Each student's prior academic work and related military experience is evaluated for courses previously completed and applicable to the student's curriculum so that academic credits may be transferred. Validation or credit by examination is encouraged where knowledge of the material has been acquired by experience or service courses.

TRANSPORTATION LOGISTICS MANAGEMENT SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Material Movement Subspecialist with a subspecialty code of 1304P. The Curriculum Sponsor is Naval Supply Systems Command Headquarters.

Typical Jobs in this Subspecialty:
Transportation Systems: CINCLANTFLT, Norfolk, VA
Transportation Logistics: CINCUSNAVEUR, London
Deputy Chief: Military Traffic Command
Director of Material Department: Naval Supply Depot/Naval Supply Center Worldwide
Director of Storage Division: Naval Supply Depot/Naval Supply Center Worldwide

ENTRY DATE

Transportation Logistics Management is a six-quarter course of study with a single entry date in July. If further information is needed, contact the Academic Associate for this curriculum or the Curriculum Officer.

Curriculum 813
Academic Associate:
Alan W. McMasters, Professor,
Code AS/Mg, Ingersoll Hall, Room 209,
(408) 646-2678, AV 878-2678.

DEGREE

Requirements for the degree Master of Science in Management are met as a milestone en route to satisfying the skill requirements of the curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3373	(4-0)	Transportation Management
OS3101	(4-1)	Statistical Analysis for Management

Quarter 3

MN3105	(4-0)	Organization and Management
MN3172	(4-0)	Public Policy Processes
MN4373	(4-0)	International Transportation Management
OS3006	(4-0)	Operations Research for Management

Quarter 4

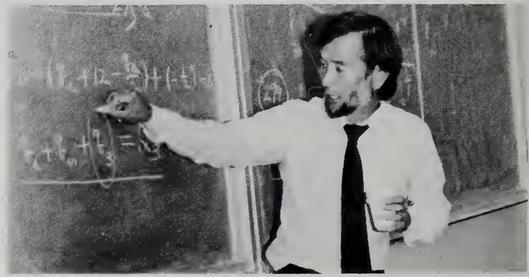
IS3183	(4-0)	Management Information Systems
MN4145	(4-0)	Policy Analysis
MN4376	(4-0)	Defense Transportation System
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
MN3377	(4-0)	Inventory Management
MN3301	(4-0)	Systems Acquisition and Project Management

Quarter 6

MN0810	(0-0)	Thesis Research
MN4105	(4-0)	Management Policy
MN3371	(4-0)	Contracts Management and Administration
MN4154	(4-0)	Financial Management in the Armed Forces



TRANSPORTATION MANAGEMENT CURRICULUM 814

The objectives of this curriculum are to prepare officers for logistics system positions within the Navy and to emphasize the worldwide transportation aspects of it. Graduate logistics courses cover topics such as the transportation system within CONUS, warehouse siting, materials management, production management, inventory management (both Navy and private sector), materials handling, purchasing and physical distribution. Students take additional courses in transportation in the private sector and military transportation in support of contingencies, as well as options in corporate financial management, production management or logistics engineering.

TRANSPORTATION MANAGEMENT SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Transportation Management Subspecialist with a subspecialty code of XX35P. The Curriculum Sponsor is Military Sealift Command Headquarters.

Typical Jobs in this Subspecialty:

Executive Officer:
    Military Sealift Command Overseas-- Guam, Okinawa, Korea, MED
Executive Officer:
    Military Sealift Command Office, CONCUS-- Seattle, New Orleans, San Diego, Anchorage
Tanker Control Officer:
    Military Sealift Command

REQUIREMENTS FOR ENTRY

A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered to be the minimum mathematical preparation. An APC of 345 is required for entry.

Officers from the U.S. Services, as well as all others, start the curriculum with widely varied academic backgrounds. Each student's prior academic work and related military experience is evaluated for courses previously completed and applicable to the student's curriculum so that academic credits may be transferred. Validation or credit by examination is encouraged where knowledge of the material has been acquired by experience or service courses.

ENTRY DATE

Transportation Management is a six-quarter course of study with a single entry date in July. If further information is needed, contact the Academic Associate for this curriculum or the Curricular Officer.

Curriculum 814
Academic Associate:
Alan W. McMasters, Professor,
Code AS/Mg, Ingersoll Hall, Room 209,
(408) 646-2678, AV 878-2678.

DEGREE

Requirements for the degree Master of Science in Management are met as a milestone en route to satisfying the skill requirements of the curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3373	(4-0)	Transportation Management
OS3101	(4-1)	Statistical Analysis for Management

Quarter 3

MN3105	(4-0)	Organization and Management
MN3172	(4-0)	Public Policy Processes
MN4373	(4-0)	International Transportation Management
OS3006	(4-0)	Operations Research for Management

Quarter 4

IS3183	(4-0)	Management Information Systems
MN 4145	(4-0)	Policy Analysis
MN4376	(4-0)	Defense Transportation System
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
MN3111	(4-0)	Personnel Management Processes
MN3301	(4-0)	Systems Acquisition and Project Management

Quarter 6

MN0810	(0-0)	Thesis Research
MN3371	(4-0)	Contracts Management and Administration
MN4105	(4-0)	Management Policy
MN4154	(4-0)	Financial Management in the Armed Forces

ACQUISITION AND CONTRACT MANAGEMENT CURRICULUM 815

The Acquisition and Contract Management Curriculum is an interdisciplinary program which integrates mathematics, accounting, economics, finance, behavioral science, management theory, operations/systems analysis and specific courses in acquisition and contracting. Inputs from the Navy are from the Supply Corps and civilians in the 1102 series. Marine Corps, Army and Coast Guard officers also participate in the program. The curriculum is designated to provide officers with the skills to serve effectively in hardware systems procurement offices, field procurement offices, contract administration offices and contracting policy support offices.

The following are a sample of the educational skill requirements of the curriculum as delineated by the curriculum sponsor:

1) Develop, implement and coordinate acquisition strategies, policies and plans.
2) Understand business finance and accounting; evaluate contractor proposals and capabilities.
3) Knowledge of system life cycle, economic analysis.
4) Have an in-depth comprehension of contract types.
5) Ability to evaluate requirements, specifications, bids, proposals and contractor performance.
6) Determine rights/obligations for settlement of controversies on government contracts.
7) Negotiate contracts and contractual issues.

REQUIREMENTS FOR ENTRY

A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered to be the minimum mathematical preparation. An APC of 345 is required for entry.

Officers from the U.S. Services, as well as all others, start the curriculum with widely varied academic backgrounds. Each student's prior academic work and related military experience is evaluated for courses previously completed and applicable to the student's curriculum so that academic credits may be transferred. Validation or credit by examination is encouraged where knowledge of the material has been acquired by experience or service courses.

ACQUISITION AND CONTRACT MANAGEMENT SUBSPECIALTY

Completion of this curriculum qualifies an officer as an Acquisition and Contract Management Subspecialist with a subspecialty code of 1306P. The Curriculum Sponsor is Naval Supply Systems Command Headquarters.

Major Ronald V. Maldonado of the U.S. Marine Corps is currently working towards his Masters in Management at the Naval Postgraduate School. His research project involves finding adequate family housing and improving existing housing for military families throughout the U.S.— a project which he finds both "rewarding and challenging."

"Congested areas, such as Southern California, where the housing off base is too expensive and housing on base is limited, have been our main focus. We're consulting with military officials and developers on public/private ventures to create more public housing, both on and off base."

Besides his research goals, Maldonado has an added incentive for improving the housing situation...his wife, Maureen and two children, Michael and Marisa. He and his family enjoy living on the peninsula and exploring the area. They find the housing situation and preschools at NPS are an added plus.

After graduation in December, the Maldonado family will head to Washington, D.C., where Maldonado will take a staff position at the Marine Corp headquarters.

Typical Jobs in this Subspecialty:

Contracting Officer:
    Ships Parts Control Center, Mechanicsburg, PA;
    Aviation Supply Office, Philadelphia, PA
Director of Contracts:
    Naval Supply Depots, Naval Supply Centers, Navy Laboratories, Navy Regional Contracting Centers
Procuring Contracting Officer, (PCO):
    Hardware Systems Commands (NAVAIR, NAVSEA, SPAWAR), Washington, DC
Business/Financial Manager (B/FM):
    Hardware Systems Commands (NAVAIR, NAVSEA, SPAWAR), Washington, DC
Contracts and Business Policy:
    Staff of Assistant Secretary of the Navy (Shipbuilding and Logistics)
    Staff of Under Secretary of Defense (Acquisition)
Administrative Contracting Officer (ACO):
    Defense Contract Administration Services (DCAS)
    Naval Plant Representative Office (NAVPRO)
Superintendent, Shipbuilding, Conversion and Repair (SUPSHIP)

ENTRY DATES

Acquisition and Contract Management is a six-quarter course of study with entry dates in January and July. If further information is needed, contact the Academic Associate for this curriculum or the Curricular Officer.

Curriculum 815
Academic Associate:
David V. Lamm, Associate Professor,
Code AS/Lt, Ingersoll Hall, Room 248,
(408) 646-2775, AV 878-2775.

DEGREE

Requirements for the degree Master of Science in Management are met as a milestone en route to satisfying the skill requirements of the curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
MN2302	(0-2)	Contract Management Seminar
IS0123	(0-2)	Computer Skills Development (as required)

Quarter 2

MN3303	(4-0)	Principles of Acquisition and Contracting
MN3140	(4-0)	Microeconomic Theory
MN3161	(4-0)	Managerial Accounting
OS3101	(4-1)	Statistical Analysis for Management
MN2302	(0-2)	Contract Management Seminar

Quarter 3

MN3312	(3-0)	Contract Law
MN3172	(4-0)	Public Policy Processes
MN3105	(4-0)	Organization and Management
MN3304	(5-2)	Contract Pricing and Negotiations
MN2302	(0-2)	Seminar

Quarter 4

MN3305	(3-0)	Contract Administration
MN4145	(4-0)	Policy Analysis
IS3183	(4-0)	Management Information Systems
NS3252	(4-0)	Joint and Maritime Strategic Planning
MN2302	(0-2)	Seminar

Quarter 5

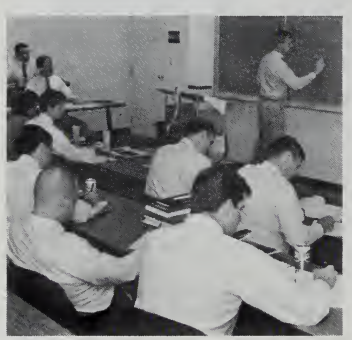
MN4301	(4-0)	Contracting for Major Systems
MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
OS3006	(4-0)	Operations Research for Management
MN2302	(0-2)	Seminar

Quarter 6

MN4371	(4-0)	Acquisition and Contracting Policy
MN4105	(4-0)	Management Policy
MN0810	(0-0)	Thesis Research Curriculum Option
MN2302	(0-2)	Seminar

ADMINISTRATIVE SCIENCES (NON USN) CURRICULUM 817

These programs are designed to provide the officers with fundamental interdisciplinary techniques of quantitative problem-solving methods, behavioral and management science, economic analysis and financial management and to enable the officers to evaluate the written research, study and analysis product of others throughout their careers. The curriculum will further provide the officers with the specific functional skills required to effectively manage.



These curricula are interdisciplinary programs which integrate mathematics, accounting, economics, behavioral science, management theory, operations/systems analysis and a subspecialty concentration area into an understanding of the process by which the defense mission is accomplished. Specialty concentration areas are specified by ordering officers into a specific curriculum.

While Allied students are free to choose any of the specific management curricula available, nearly half choose the more general Administrative Sciences International Curriculum 817. The 817 curriculum allows students to design a program of course work that is specifically useful in effectively managing in the culture uniquely characteristic of their own country's military system. The student may elect to specialize in the relevant portion of a functional area such as financial, logistics, human resources and organization, or manpower and personnel analysis. Or, the student may choose to follow a general management program which would include an overall balance of courses from many functional areas.

REQUIREMENT FOR ENTRY

A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered to be the minimum mathematical preparation. An APC of 345 is required for entry.

Officers from the U.S. Services, as well as Allied officers and DOD employees, start the curriculum with widely varied academic backgrounds. Each student's prior academic work and related military and civilian experience is evaluated for courses previously completed and applicable to the student's curriculum so that academic credits may be transferred. Validation or credit by examination is encouraged where knowledge of the material has been acquired by experience or service courses.

ENTRY DATES

Administrative Sciences for USA, USCG, USMC, DOD civilians and allied officers is a six-quarter course of study with entry dates in January and July. If further information is needed, contact the Academic Associates for this curriculum or the Curricular Officer.

Curriculum 817
Academic Associates:

USA - Management Sciences
George W. Thomas, Associate Professor,
Code AS/Te, Ingersoll Hall, Room 118,
(408) 646-2741, AV 878-2741.

USCG and DOD Civilians - Administrative Sciences
USMC - Defense Systems Analysis
James E. Suchan, Associate Professor,
Code AS/Sa, Ingersoll Hall, Room 215A,
(408) 646-2905, AV 878-2905.

International Officers - Administrative Sciences
Roger Evered, Professor,
Code AS/Ev, Ingersoll Hall, Room 201,
(408) 646-2646, AV 878-2646.

DEGREE

Requirements for the degree Master of Science in Management are met as a milestone en route to satisfying the skill requirements of the curricular program.

TYPICAL COURSE OF STUDY

ARMY

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
OA2200	(3-2)	Computational Methods for Research
OS3101	(4-0)	Statistical Analysis for Management
MN3902	(0-2)	MPT Computer Skills

Quarter 3

		Curriculum Option
MN3172	(4-0)	Public Policy Processes
OS3006	(4-0)	Operations Research for Management
MN4110	(4-0)	Multivariate Analysis 1

Quarter 4

		Curriculum Option
MN4145	(4-0)	Policy Analysis
MN3105	(4-0)	Organization and Management
IS3183	(4-0)	Management Information Systems

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
		Curriculum Option
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 6

MN0810	(0-0)	Thesis Research
		Curriculum Option
MN4105	(4-0)	Management Policy
		Curriculum Option

COAST GUARD

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3105	(3-1)	Organization and Management
OS3101	(4-0)	Statistical Analysis for Management
MN3902	(0-2)	MPT Computer Skills

Quarter 3

MN3111	(4-0)	Personnel Management Processes
MN3172	(4-0)	Public Policy Processes
MN4161	(4-0)	Financial Management Control Systems
MN4110	(4-2)	Multivariate Analysis 1

Quarter 4

		Curriculum Option
MN4145	(4-0)	Policy Analysis
IS3183	(4-0)	Management Information Systems
OS3006	(4-0)	Operations Research for Management

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
		Curriculum Option
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 6

MN0810	(0-0)	Thesis Research
		Curriculum Option
MN4105	(4-0)	Management Policy
		Curriculum Option

MARINE CORPS

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3105	(4-0)	Organization and Management
OS3101	(4-1)	Statistical Analysis for Management

Quarter 3

MN4154	(4-0)	Financial Management in the Armed Forces
MN3172	(4-0)	Public Policy Processes
MN3301	(4-0)	Systems Acquisition and Project Management
OS3006	(4-0)	Operations Research for Management

Quarter 4

OA4702	(4-0)	Cost Estimation
MN4145	(4-0)	Policy Analysis
IS3183	(4-0)	Management Information Systems
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
		Curriculum Option
		Curriculum Option

Quarter 6

		Curriculum Option
MN0810	(0-0)	Thesis Research
MN4105	(4-0)	Management Policy
		Curriculum Option

INTERNATIONAL OFFICERS

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
AS2701*	(4-0)	Communication Skills for Internationals 2
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3105	(4-0)	Organization and Management
OS3101	(4-1)	Statistical Analysis for Management

Quarter 3

		Curriculum Option
		Curriculum Option
MN3333	(4-0)	Managerial Communication Systems
OS3006	(4-0)	Operations Research for Management

Quarter 4

		Curriculum Option
MN4145	(4-0)	Policy Analysis
IS3183	(4-0)	Management Information Systems
		Curriculum Option

Quarter 5

MN0810	(0-0)	Thesis Research
		Curriculum Option
		Curriculum Option
		Curriculum Option

Quarter 6

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
MN4105	(4-0)	Strategic Management
		Curriculum Option

* Depending upon incoming English language skills.

DOD CIVILIAN PROGRAM

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3105	(4-0)	Organization and Management
OS3101	(4-1)	Statistical Analysis for Management

Quarter 3

		Curriculum Option
MN3172	(4-0)	Public Policy Processes
		Curriculum Option
OS3006	(4-0)	Operations Research for Management

Quarter 4

		Curriculum Option
MN4145	(4-0)	Policy Analysis
IS3183	(4-0)	Management Information Systems
		Curriculum Option

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
		Curriculum Option
		Curriculum Option

Quarter 6

		Curriculum Option
MN0810	(0-0)	Thesis Research
MN4105	(4-0)	Management Policy
		Curriculum Option

SYSTEMS INVENTORY MANAGEMENT CURRICULUM 819

This curriculum emphasizes the management of Navy owned inventories at all levels. Curriculum 819 students take additional courses in general inventory model development and the specific details of the Navy's inventory models, spanning the three levels of wholesale, intermediate and retail customer support. Officers are responsible for developing procedures for establishing, maintaining and controlling inventories of material, distributing that material to the Navy customer and developing the budgets for financing these inventories. The Systems Inventory Management curriculum is interdisciplinary, integrating mathematics, accounting, economics, management theory, operations analysis and the specialty concentration into an understanding of the process by which the defense mission is accomplished.

REQUIREMENTS FOR ENTRY

A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered to be the minimum mathematical preparation. An APC of 345 is required for entry.

Officers from the U.S. Services, as well as all others, start the curriculum with widely varied academic backgrounds. Each student's prior academic work and related military experience is evaluated for courses previously completed and applicable to the student's curriculum so that academic credits may be transferred. Validation or credit by examination is encouraged where knowledge of the material has been acquired by experience or service courses.

DEGREE

Requirements for the degree Master of Science in Management are met as a milestone en route to satisfying the skill requirements of the curricular program.

SYSTEMS INVENTORY MANAGEMENT SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Systems Inventory Management Subspecialist with a subspecialty code of 1302P. The Curriculum Sponsor is Naval Supply Systems Command Headquarters.

Typical Jobs in this Subspecialty:

Inventory Control Management: Naval Supply Depot/Naval Supply Center
Stock Control: Navy Shipyards
Head Inventory Control Point Polaris Material Office: Bremerton/Charleston
Director of Program Support Office Ships Parts Control Center: Mechanicsburg, PA
Director of Customer Support Office Ships Parts Control Center: Mechanicsburg, PA
Project Officer, Inventory Control
Point (ICP) Resystemization Fleet Material Support Office: Mechanicsburg, PA
Director, Retail Management Division Fleet Material Support Office: Mechanicsburg, PA
Project Officer, Inventory Accuracy and LOGMARS Fleet Material Support Office: Mechanicsburg, PA
Director, ICP Design and Procedure Department Fleet Material Support Office: Mechanicsburg, PA

REQUIREMENTS FOR ENTRY

Minimum requirements include a baccalaureate degree with above-average grades, two semesters of college algebra or trigonometry and a 345 APC.

Students are individually evaluated according to academic and military backgrounds. Course validation by examination is encouraged.

Curriculum 819
Academic Associate:
Alan W. McMasters, Associate Professor,
Code AS/Mg, Ingersoll Hall, Room 209,
(408) 646-2678, AV 878-2678.

TYPICAL COURSE OF STUDY

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3105	(4-0)	Organization and Management
OS3104	(4-0)	Statistics for Science and Engineering

Quarter 3

OA3501	(4-0)	Inventory 1
MN3172	(4-0)	Public Policy Processes
MN3372	(4-0)	Material Logistics
OS3006	(4-0)	Operations Research for Management

Quarter 4

OA4501	(4-0)	Seminar in Supply Systems
MN4145	(4-0)	Policy Analysis
MN4310	(4-0)	Logistics Engineering
IS3183	(4-0)	Management Information Systems

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
NS3252	(4-0)	Joint and Maritime Strategic Planning
MN3301	(4-0)	Systems Acquisition and Project Management

Quarter 6

MN0810	(0-0)	Thesis Research
MN4105	(4-0)	Management Policy
MN4154	(4-0)	Financial Management in the Armed Forces
MN3371	(4-0)	Contracts Management and Administration

MATERIAL LOGISTICS SUPPORT MANAGEMENT CURRICULUM 827

The Material Logistics Support Management curriculum emphasizes all of the aspects for providing integrated logistics support of weapons systems. Besides study in mathematics, accounting, economics, behavioral science, management theory and operations analysis, the curriculum delves into production management, inventory management, integrated logistic support, procurement and contract administration, systems acquisition and project management. Skills resulting from the curriculum will prepare those responsible for managing the various segments of a military system's life cycle from initial planning for support to fielding the system, through sustaining operations to phaseout.

MATERIAL LOGISTICS SUPPORT MANAGEMENT SUBSPECIALIST

Completion of this curriculum qualifies an officer as a Material Logistics Support Management Subspecialist with a subspecialty code of XX32P. The Curriculum sponsor is Naval Air Systems Command Headquarters.

Typical Jobs in this Subspecialty:

Aircraft Intermediate Maintenance: Naval Air Stations
Project Management Staff: Naval Air Systems Command, Washington, DC
Integrated Logistics Support
Coordinator for Operational Support: Naval Air Systems Command, Washington, DC
Director of Receiving Naval Supply: Depot/Naval Supply Center
Director of Storage Naval Supply: Depot/Naval Supply Center

REQUIREMENTS FOR ENTRY

A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered to be the minimum mathematical preparation. An APC of 345 is required for entry.

Officers from the U.S. Services, as well as others, start the curriculum with widely varied academic backgrounds. Each student's prior academic work and related military experience is evaluated for courses previously competed and applicable to the student's curriculum so that academic credits may be transferred. Validation or credit by examination is encouraged where knowledge of the material has been acquired by experience or service courses.

ENTRY DATES

Material Logistics Support Management is a six-quarter course of study with entry dates in January and July. If further information is needed, contact the Academic Associate for this curriculum or the Curricular Officer.

Curriculum 827
Academic Associate:
Alan W. McMasters,
Professor,
Code AS/Mg, Ingersoll Hall,
Room 209,
(408) 646-2678, AV 878-2678.

DEGREE

Requirements for the degree Master of Science in Management are met as a milestone en route to satisfying the skill requirements of the curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3105	(4-0)	Organization and Management
OS3101*	(4-1)	Statistical Analysis for Management

Quarter 3

MN3372	(4-0)	Material Logistics
MN3172	(4-0)	Public Policy Processes
MN3301	(4-0)	Systems Acquisition and Project Management
OS3006	(4-0)	Operations Research for Management

Quarter 4

MN3371	(4-0)	Contracts Management and Administration
MN4145	(4-0)	Policy Analysis
MN4310	(4-0)	Logistics Engineering
IS3183	(4-0)	Management Information Systems

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
MN3374	(4-0)	Production Management
		Curriculum Option

Quarter 6

MN0810	(0-0)	Thesis Research
MN4105	(4-0)	Management Policy
MN4154	(4-0)	Financial Management in the Armed Forces
NS3252	(4-0)	Joint and Maritime Strategic Planning

*OS3104 may be taken instead of OS3101. This substitution will allow certain curriculum option courses to be taken from the Operations Research department. The decision to take OS3104 must be made early in the first quarter.

FINANCIAL MANAGEMENT CURRICULUM 837

The objective of the Financial Management Curriculum is to prepare officers for business and financial positions within the Navy. Financial Managers assist the Navy's decision-making processes at all levels by providing accurate, timely and relevant information. They are concerned with the optimal allocation of human, physical and financial resources to achieve the Navy's goals and objectives while assuring efficient and effective expenditure of public funds.

Graduate courses cover topics such as financial reporting standards, cost standards, cost analysis, budgeting, internal control, financial auditing, operational auditing, management planning and control systems, quantitative techniques used in planning and control, and the Planning Program and Budgeting System used within the Department of Defense.

Graduates of the Financial Management Curriculum will be prepared for assignment to positions in budgeting, accounting, business and financial management, and Internal Control and Auditing.

REQUIREMENTS FOR ENTRY

A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered to be the minimum mathematical preparation. An APC of 345 is required for entry.

Officers from the U.S. Services, as well as all others, start the curriculum with widely varied academic backgrounds. Each student's prior academic work and related military experience is evaluated for courses previously completed and applicable to the student's curriculum so that academic credits may be transferred. Validation or credit by examination is encouraged where knowledge of the material has been acquired by experience or service courses.

DEGREE

Requirements for the degree Master of Science in Management are met en route to satisfying the skill requirements of the curricular program.

FINANCIAL MANAGEMENT SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Financial Management Subspecialist with a subspecialty code of XX31P. The Curriculum Sponsor is OP-92, Fiscal Management Division.

Typical Jobs in this Subspecialty:

Comptroller: Naval Air Stations
Budgeting Commander: Naval Medical Command, Washington, DC
Accounting Commander: Naval Medical Command, Washington, DC
Budget Officer Commander: Naval Air Forces Atlantic, Norfolk, VA
Comptroller: Naval Supply Depots/Naval Supply Centers
Fiscal Officer: Naval Supply Depots/Naval Supply Centers
Public Works Officer: Weapons Stations, CONUS
Cost Analysis Office of Secretary of the Navy: Washington, DC
Special Assistants Program: Planning Office (NAVY), Fiscal Management Division (OP-92)

ENTRY DATES

Financial Management is a six-quarter course of study with entry dates in January and July. If further information is needed, contact the Academic Associate for this curriculum or the Curricular Officer.

Curriculum 837
Academic Associate:
James M. Fremgen, Professor,
Code AS/Fm, Ingersoll Hall, Room 301,
(408) 646-2644, AV 878-2644.

TYPICAL COURSE OF STUDY

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3105	(4-0)	Organization and Management
OS3101	(4-1)	Statistical Analysis for Management

Quarter 3

MN4161	(4-0)	Financial Management Control Systems
MN3172	(4-0)	Public Policy Processes
MN4162	(4-0)	Cost Accounting
OS3006	(4-0)	Operations Research for Management

Quarter 4

MN4154	(4-0)	Financial Management in the Armed Forces
MN4145	(4-0)	Policy Analysis
MN4151	(4-0)	Internal Control and Auditing
IS3183	(4-0)	Management Information Systems

Quarter 5

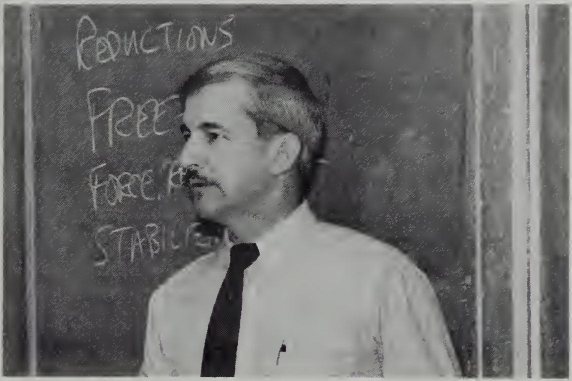
MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
		Curriculum Option
		Curriculum Option

Quarter 6

MN3301	(4-0)	Systems Acquisition and Project Management
MN0810	(0-0)	Thesis Research
MN4105	(4-0)	Management Policy
NS3252	(4-0)	Joint and Maritime Strategic Planning

MANPOWER, PERSONNEL AND TRAINING ANALYSIS CURRICULUM 847

Officers enrolled in the Manpower, Personnel and Training Analysis (MPTA) curriculum at the Naval Postgraduate School undertake the challenge of an academic program designed to fill the leadership roles in military manpower management. The XX33 Subspecialty has primary responsibility for developing and analyzing policies to ensure that the Navy is recruiting, training, utilizing and retaining personnel in the most efficient and effective ways possible. MPTA is an extremely analytical curriculum intended to develop skills necessary to perform and evaluate manpower analyses. As such, the curriculum emphasizes mathematical, statistical and other quantitative methods. Successful completion of the curriculum yields an officer skilled in conducting manpower policy analysis.



The areas covered in the MPTA curriculum include an understanding of MPT policy development, compensation systems, productivity analysis, enlistment supply and retention models, manpower training models, manpower requirements determination processes, career mix, enlistment incentives, reenlistment incentives, training effectiveness measures and hardware/manpower trade-offs. Students gain familiarity with current models and methods of MPT analysis as well as military MPT organizations and issues.

REQUIREMENTS FOR ENTRY

A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered to be the minimum mathematical preparation. Additional preparation in calculus and statistics is considered very advisable. An APC of 345 is required for entry.

Prospective students electing MPTA as a subspecialty must be adequately prepared by their undergraduate curriculum and comfortably oriented to a quantitatively rigorous graduate curriculum.

Officers from the U.S. Services, as well as all others, start the curriculum with widely varied academic backgrounds. Validation by examination is encouraged where knowledge of the material has been acquired by experience or service courses.

DEGREE

Requirements for the degree Master of Science in Management are met as a milestone en route to satisfying the skill requirements of the curricular program.

MANPOWER, PERSONNEL AND TRAINING ANALYSIS SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Manpower, Personnel and Training Analyst Subspecialist with a subspecialty code of XX33P. The Curriculum Sponsor is OP-11, Total Force Training and Education Division.

Typical Jobs in this Subspecialty:

Head, Ship Manpower Requirements Section:
- Deputy Chief of Naval Operations (Manpower, Personnel and Training)
- Director Total Force Programming/Manpower Division OP-12, Washington, DC

Programmed Objective Memorandum (POM) Operations:
- Deputy Chief of Naval Operations (Manpower, Personnel and Training)
- Director Total Force Programming/Manpower Division, OP-12, Washington, DC

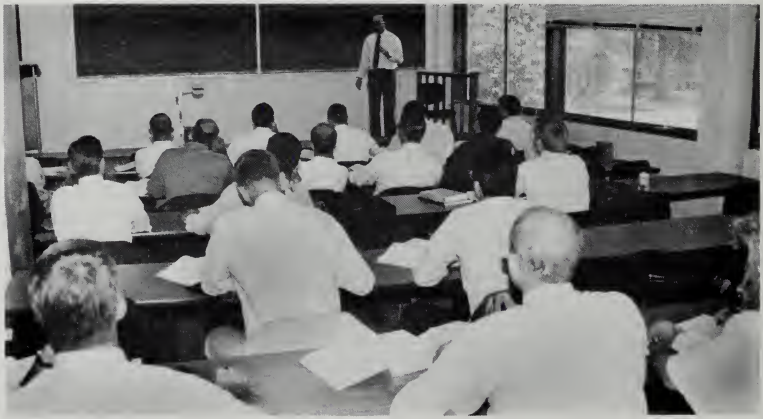
Manager (OP-12A):
- Deputy Chief of Naval Operations (Manpower, Personnel and Training)
- Director Total Force Programming/Manpower Division OP-12, Washington, DC

Total Force Mobilization Plans Branch:
- Deputy Chief of Naval Operations (Manpower, Personnel and Training)
- Director Military Personnel Policy Division (OP-134G), Washington, DC

Head, Officer Procurement Plans Section (OP-130D)

ENTRY DATES

Manpower, Personnel and Training Analysis is a six-quarter course of study with entry dates in January and July. If further information is needed, contact the Academic Associate for this curriculum or the Curricular Officer.



Curriculum 847
Academic Associate:
Mark J. Eitelberg, Associate Professor,
Code AS/Eb, Ingersoll Hall, Room 234,
(408) 646-3160, AV 878-3160.

TYPICAL COURSE OF STUDY

Quarter 1

MN2150	(4-0)	Financial Accounting
MN2031	(4-0)	Economic Decision Making
MN3333	(4-0)	Managerial Communication Skills
MA2300	(5-0)	Mathematics for Management
MN2111	(0-2)	Seminar in MPTA Issues
IS0123	(0-2)	Computer Skills Development

Quarter 2

MN3161	(4-0)	Managerial Accounting
MN3140	(4-0)	Microeconomic Theory
MN3105	(4-0)	Organization and Management
OS3101	(4-1)	Statistical Analysis for Management
MN2112	(0-2)	Seminar in MPTA Issues
MN3902	(0-2)	Computer Skills Enhancement

Quarter 3

MN3760	(4-0)	Manpower Economics
MN3111	(4-0)	Personnel Processes
OS3006	(4-0)	Operations Research for Management
MN4110	(5-2)	Multivariate Manpower Data Analysis 1
MN2113	(0-2)	Seminar in MPTA Issues

Quarter 4

MN4761	(4-0)	Applied Manpower Analysis
MN4500	(4-0)	Productivity Analysis
OS4701	(4-0)	Manpower and Personnel Models
MN4111	(5-2)	Multivariate Manpower Data Analysis 2

Quarter 5

MN0810	(0-0)	Thesis Research
MN0810	(0-0)	Thesis Research
		Curriculum Option
MN4106	(4-0)	Manpower Policy Analysis
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 6

MN0810	(0-0)	Thesis Research
MN3172	(4-0)	Public Policy Processes
IS3183	(4-0)	Management Information Systems
MN4105	(4-0)	Management Policy
MN4904	(0-2)	Advanced MPTA Research Applications

Curricular Officer:
James M. Daniel,
CDR, USN,
Code 31, Halligan Hall.
Room 133,
(408) 646-2491,
AV 878-2491.

AERONAUTICAL ENGINEERING AND AERONAUTICAL ENGINEERING WITH AVIONICS
CURRICULA 610 and 611

The Aeronautical Engineering programs are designed to meet the specific needs of the Navy's Operational Technical Managerial System (OTMS) for technical managers with a broad-based graduate education in Aeronautical Engineering. While an undergraduate degree in engineering is preferred, special preparatory programs can accommodate officers with widely varying academic backgrounds.

The Aeronautical Engineering programs are designed to give the student a broad technical and engineering education in the four principal areas of aeronautics: gas dynamics, flight dynamics, propulsion and flight structures. Additionally, officers receive graduate level instruction in aircraft/missile design and aero-computer science. Students in the 611 Curriculum receive additional emphasis on avionics systems. The programs are divided into preparatory, graduate and advanced graduate phases. The preparatory phase is tailored to each officer's background and is programmed for minimum time consistent with capability. After the preparatory phase, a common graduate core is completed by both the 610 and 611 students. This phase includes advanced studies in propulsion, aerodynamic analysis, structural analysis and stability and control. During the advanced graduate phase, all students receive in-depth graduate coverage through advanced electives in areas of their choice including flight dynamics, gas dynamics, propulsion and structures. Students in Curriculum 611 receive advanced studies in guidance and control, radar systems and electronic warfare.

ENTRY DATES

Aeronautical Engineering is an eight-quarter course of study with entry dates in April and October. Those requiring the Engineering Science Curriculum will have their time of arrival adjusted to accommodate it. If further information is needed, contact the Academic Associate or the Curricular Officer for this curriculum.

Curricular 610 and 611
Academic Associate:
Gerald H. Lindsey, Professor,
Code AA/Li, Halligan Hall, Room 223,
(408) 646-2808, AV 878-2808.

DEGREE

Requirements for the degree Master of Science in Aeronautical Engineering are met as a milestone en route to satisfying the skill requirements of the curricular programs.

REQUIREMENTS FOR ENTRY

A baccalaureate degree, or its equivalent, with an above-average QPR, preferably in engineering or the physical sciences, is required. In addition, mathematics through differential and integral calculus, with above-average grades and completion of a calculus-based physics sequence with above-average grades is also required. An APC of 323 is the requirement for direct entry, but the Engineering Science Program (Curriculum 460) is available for candidates who do not meet all the admission requirements for direct entry. The required APC for entry via Curriculum 460 is 334.

AERONAUTICAL ENGINEERING SUBSPECIALTY

Completion of this curriculum qualifies an officer as an Aeronautical Engineering Subspecialist with a subspecialty code of XX71P. The Curriculum Sponsor and primary consultant is the Naval Air Systems Command.

Typical Jobs in this Subspecialty:

Project Officer- Power Plants: Naval Air Systems Command
Weapons Systems Manager: Naval Air Rework Facility, Pensacola, FL
Commanding Officer: Naval Plant Representative Office, Stratford, CT
Attack Aircraft Class Desk: COMNAVAIRLANT, Norfolk, VA
Aeronautical Engineer: Defense Nuclear Agency Headquarters
Instructor, Aeronautical Engineer: U.S. Naval Academy, Annapolis, MD
Deputy Project Manager for the E-2: Naval Air Systems Command
VP Program Director: Naval Air Development Center

TYPICAL COURSE OF STUDY

Quarter 1

AE2042	(3-2)	Fundamentals of Thermo-fluid Dynamics
AE2440	(3-2)	Modern Methods of Engineering Computation
EC2170	(4-1)	Introduction to Electrical Engineering
MA2047	(4-0)	Linear Algebra and Vector Analysis

Quarter 2

AE2021	(4-1)	Introduction to Flight Structures
AE2035	(3-2)	Basic Aerodynamics
AE2042	(3-2)	Fundamentals of Gas Dynamics
MA2121	(4-0)	Differential Equations

Quarter 3

AE2036	(3-2)	Performance and Static Stability
AE2801	(3-2)	Aero - Laboratories I
EC2020	(3-0)	Linear Systems
MA3132	(4-0)	Partial Differential Equations and Integral Transforms

Quarter 4

AE2451	(3-2)	Aircraft and Missile Propulsion
AE3101	(3-2)	Flight Vehicle Structural Analysis
AE3340	(3-2)	Linear Vibration and Dynamic Stability
AE3501	(3-2)	Current Aerodynamic Analysis

Quarter 5

AE3202	(3-2)	Structural Failure, Fracture and Fatigue
AE3341	(3-2)	Aerospace Controls
AE3802	(3-2)	Aero-Laboratories II
AE4632	(3-2)	Computer Methods in Aeronautics

Quarter 6

AE4201	(3-2)	Reliability and Systems Safety
AE4273	(3-2)	Aircraft Design
AE0810	(0-0)	Thesis Research
MS3201	(3-2)	Materials Science and Engineering

Quarter 7

AE4XXX		Elective
AE4XXX		Elective
AE0810	(0-0)	Thesis Research
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 8

AE4306	(3-2)	Helicopter Design
or		Advanced Elective
AE4XXX		Advanced Elective
AE0810	(0-0)	Thesis Research
AE0810	(0-0)	Thesis Research

AERONAUTICAL ENGINEERING WITH AVIONICS SUBSPECIALTY

Completion of this curriculum qualifies an officer as an Aeronautical Engineer with an Avionics Subspecialty and a subspecialty code of XX72P. The Curriculum Sponsor is the Naval Air Systems Command.

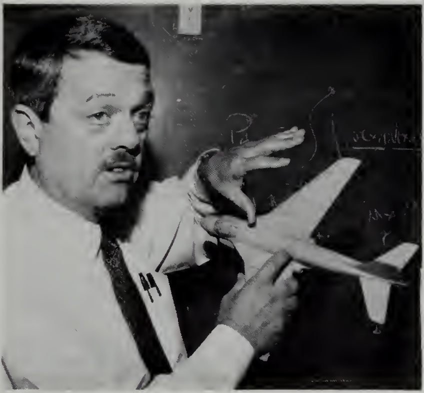
Lieutenant Commander Dan Bursch is the most recent Naval Postgraduate School graduate to enter NASA's astronaut program. Bursch, who dreamed of being an astronaut since he was in grade school, reported to Johnson Space Center in Houston, Texas in July 1990 for one year of training and evaluation.

In 1984, while at the Naval Test Pilot School, Bursch learned that NASA was interested in Naval Flight Officers as Mission Specialists. Since that time, he has been applying to the program each year.

"Graduate education is a key.selection criteria for Mission Specialists— and for pilots, it seems, after seeing the latest group of pilots selected. The Naval Postgraduate School played a key role in helping me achieve my goal, and I would strongly recommend NPS to anyone interested in the space program.

"The environment at the school, both professional and academic, is unequaled anywhere. Officers with the desire to improve themselves, who are ready for one of the most fulfilling challenges of their life, should come to NPS."

Typical Jobs in this Subspecialty:
Weapons Officer:
  CVN 69 Eisenhower
VS Program Director:
  Naval Air Development Center
A/C Maintenance/Avionics Officer:
  Naval Air Engineering Center
Aircraft Systems Project Pilot:
  Naval Weapons Center



TYPICAL COURSE OF STUDY

Quarter 1

AE2042	(3-2)	Fundamentals of Thermo-fluid Dynamics
AE2440	(3-2)	Modern Methods of Engineering Computation
EC2210	(3-2)	Electronics Engineering
MA2047	(4-0)	Linear Algebra and Vector Analysis

Quarter 2

AE2035	(3-2)	Basic Aeronautics
AE2043	(3-2)	Fundamentals of Gas Dynamics
EC2600	(4-0)	Introduction to Fields and Waves
MA2121	(4-0)	Differential Equations

Quarter 3

AE2036	(3-2)	Performance and Static Stability
EC2410	(3-0)	Fourier Analysis of Signals and Systems
EC2420	(3-0)	Linear Systems
EC2610	(3-1)	Electromagnetic Engineering

Quarter 4

AE3340	(3-2)	Linear Vibration and Dynamic Stability
AE3451	(3-2)	Aircraft and Missile Propulsion
EC3600	(3-2)	Electromagnetic Radiation, Scattering and Propogation
MA3132	(4-0)	Partial Differential Equations and Integral Transforms

Quarter 5

AE3276	(3-2)	Introduction to Avionics
AE3341	(3-2)	Aerospace Controls
AE4641	(3-2)	Aeronautical Data Systems
EC2500	(3-2)	Communications Theory

Quarter 6

AE4276	(3-2)	Avionics System Design
AE4342	(3-2)	Advanced Control for Aerospace Systems
EC2670	(4-2)	Principles of Radar Systems
AE0810	(0-0)	Thesis Research

Quarter 7

NS3252	(4-0)	Joint and Maritime Strategic Planning
AE4XXX		Elective
AE4XXX		Elective
AE0810	(0-0)	Thesis Research

Quarter 8

AE4201	(3-2)	Reliability and Systems Safety
EC4670	(4-1)	Electronic Warfare
AE0810	(0-0)	Thesis Research
AE0810	(0-0)	Thesis Research

NPS/TPS COOPERATIVE PROGRAM

A program which combines portions of the 610 curriculum at the NP with the completed U.S. Naval Test Pilot School syllabus is currentl available to selected officers with strong undergraduate engineering backgrounds. After the completion of four/five quarters of study at NPS, selectees proceed to Patuxent River for the full Test Pilot Scho Curriculum. This NPS/TPS Cooperative Program results in a test pilot designation, XX73G, the Aeronautical Engineering subspecialt code XX71P and award of the master's degree in Aeronautical Engineering at the completion of the test pilot school.

TYPICAL COURSE OF STUDY

Quarter 1

AE2021	(4-1)	Introduction to Flight Structures
AE2035	(3-2)	Basic Aerodynamics
MA2047	(4-0)	Linear Algebra and Vector Analysis
MS3201	(3-2)	Materials Science and Engineering

Quarter 2

AE2042	(3-2)	Fundamentals of Thermo-fluid Dynamics
AE2440	(3-2)	Modern Methods of Engineering Computation
MA2121	(4-0)	Differential Equations
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 3

AE2043	(3-2)	Fundamentals of Gas Dynamics
AE3101	(3-2)	Flight Vehicle Structural Analysi
AE3501	(3-2)	Current Aerodynamic Analysis
MA3132	(4-0)	Partial Differential Equations an Integral Transforms

Quarter 4

AE3202	(3-2)	Structural Failure, Fracture and Fatigue
AE3802	(3-2)	Aero-Laboratories II
AE4632	(3-2)	Computer Methods in Aeronautics
AE4XXX		Elective

Quarter 5

AE3251	(4-2)	Aircraft Combat Survivability
AE4273	(3-2)	Aircraft Research
AE4XXX		Elective
AE4XXX		Elective

METEOROLOGY
CURRICULUM 372

This curriculum will provide qualified non-USN personnel with a ound understanding of the science of meteorology. The student will develop the technical expertise to assess and forecast the impact of tmospheric conditions on operations:

) To understand the science of meteorological data and models.

) To sample/measure, analyze and predict atmospheric conditions.

) To operate and control data/information management systems.

) To plan, conduct, interpret and present results of research activities.

Curricular Officer:
Timothy K. Cummings,
CDR, USN
Code 35, Root Hall, Room 216,
(408) 646-2044,
AV 878-2044.

REQUIREMENTS FOR ENTRY

This program is open to International Officers, officers from other services and DOD civilians. It is open to Oceanography (1800) officers of the U.S. Navy as a Ph.D. program.

A baccalaureate degree with completion of mathematics through differential and integral calculus and a minimum of one year of college physics is required. An APC of 323 is required for direct entry. The Engineering Science Curriculum 460 is available for candidates who do not meet all admission requirements for direct entry.

ENTRY DATES

Meteorology is a seven-quarter course of study with preferred entry dates in April and October. A six-week technical refresher in calculus and physics is available preceding the entry dates. Also available during the refresher are short courses in FORTRAN programming and introduction to Meteorology. For further information contact the the Curricular Officer, CDR Timothy K. Cummings. Academic questions may be referred directly to the Academic Associate.

Curriculum 372
Academic Associate:
Roger T. Williams, Professor,
Code MR/Wu, Root Hall, Room 247,
(408)646-2296, AV 878-2296.

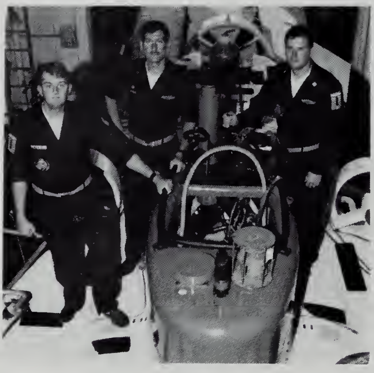
DEGREE

Master of Science in Meteorology.

TYPICAL COURSE OF STUDY

Quarter 1

MA2047	(4-1)	Linear Algebra and Vector Analysis
MA2121	(4-0)	Differential Equations
MR/OC2020	(1-2)	Computer Computations in Air-Ocean Sciences
MR3480	(3-0)	Atmospheric Thermodynamics and Radiative Processes
MR/OC3140	(3-2)	Probability and Statistics for Air-Ocean Sciences



Quarter 2

MR/OC3321	(4-0)	Air-Ocean Fluid Dynamics
MR/OC3522	(4-2)	Remote Sensing of the Atmospher and Ocean/Laboratory
MA3132	(4-0)	Partial Differential Equations and Intergal Transforms
MR/OC3150	(3-2)	Analysis of Air-Ocean Time Series

Quarter 3

MR4322	(4-0)	Dynamic Meteorology
MR4415	(3-0)	Atmospheric Turbulence
		Track Option

Quarter 4

MR3234	(4-4)	Tropospheric and Stratospheric Meteorology/Lab
		Track Option
		Track Option

Quarter 5

MR3252	(3-4)	Tropical Meteorology/Lab
MR4241	(3-0)	Mesoscale Meteorology
MR/OC4323	(4-2)	Numerical Air and Ocean Modeling
MR4416	(3-3)	Atmospheric Factors in EM and Optical Propagation

Quarter 6

MR3262	(3-5)	Operational Atmospheric Prediction/Lab
MR0810	(0-0)	Thesis Research
MR0810	(0-0)	Thesis Research
		Track Option

Quarter 7

MR0999	(2-0)	Seminar in Meteorology
MR0810	(0-0)	Thesis Research
		Track Option
		Track Option

AIR-OCEAN SCIENCES
CURRICULUM 373

This curriculum in meteorology and oceanography involves approximately 120-quarter hours of classroom lectures, supplemented by an additional 35-quarter hours of laboratory exercises. This program is designed to provide the student with:

1) A thorough understanding of the principles governing the physical and dynamic properties of the oceans and atmosphere.

2) The ability to analyze and predict oceanic and atmospheric parameters and conditions using direct and remote sensing observational techniques, statistical analyses and numerical models.

3) A thorough understanding of the effects of oceanic and atmospheric properties and conditions on weapon, sensor and platform performance while conducting and supporting Naval warfare with particular emphasis on ocean acoustics and electromagnetic/optical propagation.

An educationally significant oceanographic and meteorological experience at sea.

An oceanographic or meteorological research experience germane to Naval warfare culminating in a thesis of professional quality.

An understanding of Maritime Strategic Planning. This education will enhance performance in all duties throughout a career, including operational billets, technical management assignments and policy making positions. Students will develop graduate-level technical ability based upon scientific principles, acquire diverse professional knowledge and develop analytical ability for practical problem solving.

EQUIREMENTS FOR ENTRY

is program is open to Oceanography (1800) Officers, officers from her services, International Officers and DOD Civilians.

baccalaureate degree in the physical sciences, mathematics or gineering is required. Completion of mathematics through fferential and integral calculus and one year of calculus-based llege physics are required. An APC of 323 is required for direct try. The Engineering Science Curriculum 460 is available for ndidates who do not meet all admission requirements for direct try.

Philip Durkee
Associate Professor, Meteorology

For Philip Durkee, probably the most outstanding thing about the Naval Postgraduate School is the enthusiasm of the students. “Some of the things that I’ve enjoyed the most in working with students here is their motivation level — to work on scientific problems and problems that are applicable to fleet operations and fleet needs.

“Students come here expecting the rigorous academic life; what they don’t expect is the opportunity to work on high quality research and scientific investigations,” says Durkee.

Durkee is studying the effects of clouds, smoke, dust and haze on the propagation of electromagnetic radiation, using multi-wavelength satellite sensors. “Certainly in my research, which may be applied to everything from naval problems to the whole area of climate and climate change, I would not be able to produce the results I have without the direct input and efforts of the students.”

He is also in the process of procuring a transportable real time satellite data receiver to use in a number of field experiments. “There will be lots of opportunities for students to get involved. We will direct research aircraft and ships to regions where we see the clouds or dust or smoke in an interesting pattern. Some of the places we plan to go are the Azores, the Arctic and central and south Pacific Ocean.”

From Durkee’s viewpoint, “The Naval Postgraduate School provides a challenging academic environment and a chance for officers to take a short break from their operational military career to gain a perspective of what is on the cutting edge of scientific research.”

AIR-OCEAN SCIENCE SUBSPECIALTY

Completion of this curriculum qualifies an officer as an Air-Ocean Subspecialist with a subspecialty code of XX47. The Curriculum Sponsor is OP-096, Oceanographer of the Navy.

Typical Jobs in this Subspecialty:
Commanding Officer: Oceanographic Unit
Oceanographer: CV/BB
Submarine Group Staff
Fleet Staff
CARGRU/CRUDESGRU Staff
O in C Naval Oceanography: Command Detachment
NAVOCEANCOM Center
Defense Mapping Agency
Office of Naval Research

ENTRY DATES

Air-Ocean Sciences is a nine-quarter course of study with preferred entry dates in April and October. A six-week technical refresher in calculus and physics is available preceding these entry dates. Also available during the refresher are short courses in FORTRAN programming and Introduction to Meteorology. If further information is needed, contact the Curricular Officer. Academic questions may be referred directly to either of the Academic Associates.

Curriculum 373
Academic Associates:
Roger T. Williams, Professor,
Code MR/Wu, Root Hall, Room 247,
(408) 646-2296, AV 878-2296.

Roland W. Garwood, Jr., Professor,
Code OC/Gd, Spanagel Hall, Room 308,
(408) 646-3260, AV 878-3260.

DEGREE

Master of Science in Meteorology and Physical Oceanography.

TYPICAL COURSE OF STUDY

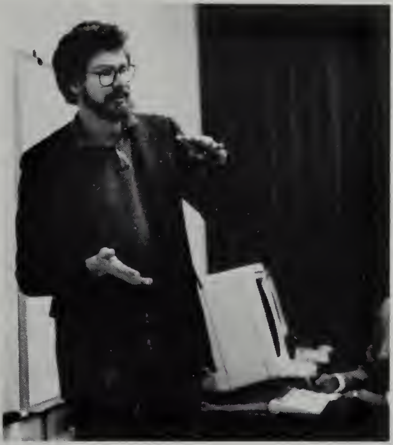
Quarter 1

MA1118	(5-2)	Multivariable Calculus
MA2121	(4-0)	Differential Equations
MR/OC3140	(3-2)	Probability and Statistics for Air-Ocean Science
MR3480	(4-1)	Atmospheric Thermodynamics and Radiative Processes
OC3230	(3-1)	Descriptive Physical Oceanography

Quarter 2

MA2121	(4-0)	Differential Equations
MR/OC3321	(4-0)	Air-Ocean Fluid Dynamics
MR/OC3522	(4-2)	Remote Sensing of the Atmosphere and Ocean/Laboratory
MA2047	(4-1)	Vector Analysis and Linear Algebra

uarter 3		
A3132	(4-0)	Partial Differential Equations
R4322	(4-0)	Dynamic Meteorology
R3222	(4-3)	Meteorological Analysis
C3420	(4-2)	Ocean Dynamics I
uarter 4		
R/OC3150	(3-2)	Analysis of Air-Ocean Time Series
C4211	(4-0)	Ocean Dynamics II
R3234	(4-4)	Tropospheric and Stratospheric Analysis/ Lab
R/OC4XXX	(4-0)	Track Option
uarter 5		
R3252	(3-4)	Tropical Meteorology
R/OC4413	(4-1)	Air-Sea Interaction
C4331	(4-0)	Mesoscale Ocean Variability
C3260	(4-0)	Sound in the Ocean
uarter 6		
R/OC3212	(4-0)	Polar Meteorology/ Oceanography
R/OC4323	(4-2)	Numerical Air and Ocean Modelling
C4267	(4-3)	Ocean Influences in Underwater Acoustics
R/OC4900	(3-0)	Special Topics in Meteorology/Oceanography
uarter 7		
R3262	(3-5)	Operational Atmospheric Prediction
R4416	(4-0)	Atmospheric Factors in EM and Optical Propagation
C/PH4XXX	(4-0)	Acoustics Track Option
R/OC0810		Thesis Research
uarter 8		
C3266	(2-2)	Tactical Applications of Oceanography
R/OC4XXX	(4-0)	Track Option
R/OC4XXX	(4-0)	Track Option
R/OC0810		Thesis Research
uarter 9		
S3252	(4-0)	Joint and Maritime Strategic Planning
R/OC4XXX	(4-0)	Track Option
R/OC0810		Thesis Research
R/OC0999		Thesis Presentation



OPERATIONAL OCEANOGRAPHY CURRICULUM 374

This flexible oceanography curriculum involves approximately 100-quarter hours of classroom lectures, supplemented by an additional 20-quarter hours of laboratory exercises. This program is designed t provide the student with:

1) A thorough understanding of the principles governing the physical and dynamic properties of the oceans.

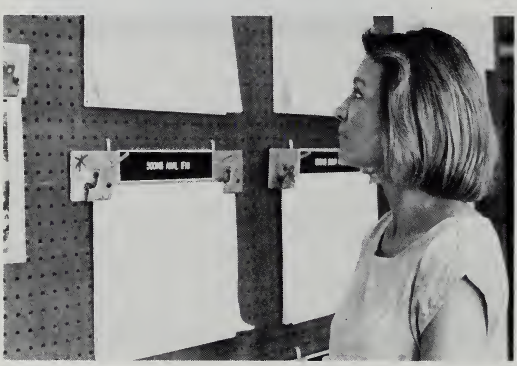
2) An understanding of the analysis and prediction of oceanic and atmospheric parameters and conditions using direct and remote sensing observational techniques, statistical analyses, and numerical models.

3) An understanding of the effects of oceanic and atmospheric properties and conditions on weapon, sensor and platform performance while conducting and supporting Naval warfare with particular emphasis on ocean acoustics.

4) An educationally significant oceanographic experience at sea.

5) An oceanographic or meteorological research experience german to Naval warfare culminating in a thesis of professional quality.

6) An understanding of Maritime Strategic Planning.



The Operational Oceanography Curriculum has a physical oceanography and ocean acoustics base and is a very flexible program The student selects an oceanography application Enhanced Track Option (ETO) in Antisubmarine Warfare, Engineering Acoustics, Operations Analysis, Space Systems Operations or Space Systems Engineering. An additional ETO for 1100 and 13XX officers is Meteorology which results in a curriculum similar to 373, Air-Ocean Science. Examples of the various programs are shown below. This program is open to Unrestricted Line (1100, 1100, 1120, 1310, 1320) Officers, officers from other services, International Officers and DOD civilians.

REQUIREMENTS FOR ENTRY

A baccalaureate degree in the physical sciences, mathematics or engineering is desirable. Completion of mathematics through differential and integral calculus and one year of calculus-based college physics are required. An APC of 323 is required for direct entry. The Engineering Science Program (Curriculum 460) is available for candidates who do not meet all admission requirements for direct entry.

OPERATIONAL OCEANOGRAPHY SUBSPECIALTY

Completion of this curriculum qualifies an officer as an Operational Oceanography Subspecialist with a subspecialty code of XX49. The curriculum sponsor is OP-096, Oceanographer of the Navy.

ypical Jobs in this Subspecialty:
V A.S.W. Module
RUDESGRU/CARGRU Staff
.S.W. Operations Center
avy Laboratories
ffice of Naval Research
ACLANT A.S.W. Research Center La Spezia, Italy
aval Oceanographic Research and Development Agency (NORDA)
efense Mapping Agency

NTRY DATES

perational Oceanography is an eight-quarter course of study with referred entry dates in April and October. If further information is eeded, contact the Academic Associate or the Curricular Officer for his curriculum.

urriculum 374
cademic Associate:
oland W. Garwood, Professor
ode OC/Gd, Spanagel Hall, Room 308,
408) 646-3260, AV 878-3260.

EGREE

he primary degree is a Master of Science in Physical Oceanography. tudents who select the Meteorology Enhanced Track Option (ETO) eceive a Master of Science in Meteorology and Physical ceanography. Students who select the Engineering Acoustics ETO, nd maintain a GQPR above 3.50, may receive duel Master of Science egrees in Physical Oceanography and Engineering Acoustics.

YPICAL COURSE OF STUDY

uarter 1

R/OC3140	(3-2)	Probability and Statistics for Air-Ocean Science
S3252	(4-0)	Joint and Maritime Strategic Planning
C3230	(3-1)	Descriptive Physical Oceanography
A1118	(5-2)	Multivariable Calculus

uarter 2

R/OC3522	(4-2)	Remote Sensing of the Atmosphere and Oceans/Laboratory
R/OC3321	(4-0)	Air-Ocean Fluid Dynamics
A2047	(4-1)	Vector Analysis and Linear Algebra
A2121	(4-0)	Differential Equations

uarter 3

		Track Option
C3260	(4-0)	Sound in the Ocean
C3240	(4-2)	Ocean Dynamics I
A3132	(4-0)	Partial Differential Equations and Integral Transforms

Quarter 4

		Track Option
MR/OC4267	(4-3)	Ocean Influences in Underwater Acoustics
OC4211	(4-0)	Ocean Dynamics II
MR/OC3150	(3-2)	Analysis of Air-Ocean Time Series

Quarter 5

		Track Option
MR/OC4413	(4-0)	Air-Sea Interaction
MR3222	(4-3)	Meteorological Analysis
MR/OC4900	(3-0)	Special Topics in Meteorology/ Oceanography

Quarter 6

		Track Option
		Track Option
OC4XXX	(4-0)	Oceanography Elective
MR/OC0810		Thesis Research

Quarter 7

		Track Option
		Track Option
MR/OC0810		Thesis Research
MR/OC3570	(2-4)	Operational Oceanography and Meteorology

Quarter 8

		Track Option
OC3266	(2-2)	Tactical Applications of Oceanography
MR/OC0810		Thesis Research
MR/OC0999		Thesis Presentation

TYPICAL TRACK OPTION/SUBSTITUTE COURSES

Meteorology

MR4322	(4-0)	Dynamic Meteorology
OC4331	(4-0)	Mesoscale Ocean Variability
MR3252	(3-1)	Tropical Meteorology
MR/OC3212	(4-0)	Polar Meteorology and Oceanography
MR4416	(4-0)	Atmospheric Factors in Electromagnetic and Optical Propagations
MR3262	(3-5)	Operational Atmospheric Prediction
MR/OC4323	(4-2)	Numerical Air and Ocean Modelling
MR3234	(4-1)	Tropospheric and Stratospheric Analysis/ Laboratory

Antisubmarine Warfare

OS2103	(4-1)	Applied Probability
OS3604	(4-0)	Decision and Data Analysis
EO2720	(4-2)	Introduction to Electronic Systems
OS3303	(4-1)	Computer Simulation
OS3601	(4-0)	Search, Detection and Localization Models
OA4607	(3-2)	Tactical Decision Aids
PH4403	(4-1)	Advanced Topics in Underwater Acoustics
PH3002	(4-0)	Non-Acoustic Sensor Systems
MR2413	(3-1)	Meteorology of Antisubmarine Warfare
MR/OC3525	(4-2)	Air-Ocean Remote Sensing

Engineering Acoustics

OS3104	(4-0)	Statistics for Science and Engineering
PH3451	(4-2)	Fundamental Acoustics
EC2500	(3-2)	Principles of Communications Systems
PH3452	(4-2)	Underwater Acoustics
PH4454	(4-2)	Transducer Theory and Design
PH4455	(4-0)	Sound Propagation in the Ocean
PH4453	(4-0)	Scattering and Fluctuations
OC4490	(3-0)	Ocean Acoustic Tomography
EC4450	(4-1)	Sonar Systems Engineering
EC4570	(4-0)	Decision and Estimation Theory
MR/OC3525	(4-2)	Air-Ocean Remote Sensing

Operations Analysis

OA3101	(4-1)	Probability
OS3104	(4-0)	Statistics for Science and Engineering
OA3301	(4-0)	Stochastic Models
OS3601	(4-0)	Search, Detection and Localization Models
OS3303	(4-1)	Computer Simulation
OS3008	(4-0)	Analytical Planning Methodology
OA4607	(3-2)	Tactical Decision Aids
OS3603	(3-1)	Simulation and Wargaming
MR2413	(3-1)	Meteorology of Antisubmarine Warfare
MR/OC3525	(4-2)	Air-Ocean Remote Sensing

Space Systems Operations

PH2511	(4-0)	Introduction to Orbital Mechanics
PH2514	(4-0)	Introduction to the Space Environment
SS3001	(4-0)	Military Applications of Space
SS4001	(4-0)	Decisions and Space Systems
AE4830	(3-2)	Spacecraft Systems I
AE4831	(4-0)	Spacecraft Systems II
MR2413	(3-1)	Meteorology of Antisubmarine Warfare
MR/OC3525	(4-2)	Air-Ocean Remote Sensing

Space Systems Engineering

PH2511	(4-0)	Introduction to Orbital Mechanics
PH2514	(4-0)	Introduction to the Space Environment
SS3001	(4-0)	Military Applications of Space
AE2820	(3-2)	Introduction to Spacecraft Structures
AE3815	(4-0)	Introduction to Spacecraft Dynamics
EO3740	(3-1)	Space Power and Radiation Effects
AE3850	(4-0)	Propulsion for Space Applications
AE4818	(3-1)	Spacecraft Attitude Dynamics and Control
AE3804	(3-0)	Thermal Control of Spacecraft
AE4870	(4-0)	Spacecraft Design and Integration
MR2413	(3-1)	Meteorology of Antisubmarine Warfare
MR/OC3525	(4-2)	Air-Ocean Remote Sensing

OCEANOGRAPHY
CURRICULUM 440

The Oceanography Curriculum provides students with a sound understanding of the science of oceanography. The student develops the technical expertise to provide and use oceanographic and acoustical data and models in support of all aspects of at-sea operations. The graduate will be able to:

1) Interpret and predict oceanic and air-ocean interface conditions.

2) Operate modern oceanographic data management, archival and communications systems.

3) Plan, conduct, interpret and present results of research activities.

This education further enhances performance in operational billets, technical management assignments and policy making positions. Students will develop sound, graduate-level technical ability based on scientific principles.

REQUIREMENTS FOR ENTRY

This program is open to International Officers, officers from other services and DOD civilians. It is open to Oceanography (1800) officers as a Ph.D. program.

A baccalaureate degree in the physical sciences, mathematics or engineering is required. Completion of mathematics through differential and integral calculus and one year of calculus-based college physics are required. An APC of 323 is required for direct entry. The Engineering Science Program (Curriculum 460) is available for candidates who do not meet all admission requirements for direct entry.

ENTRY DATES

Oceanography is an eight-quarter course of study with entry dates in April and October. A six-week technical refresher in calculus and physics is available preceding these entry dates. Also available during the refresher is a short course in FORTRAN programming. If further information is needed, contact the Curricular Officer for this curriculum. Academic questions may be referred directly to the Academic Associate.

Curriculum 440
Academic Associate:
Roland W. Garwood, Professor
Code OC/Gd, Spanagel Hall, Room 308,
(408)646-3260, AV 878-3260.

DEGREE

Master of Science in Physical Oceanography.

TYPICAL COURSE OF STUDY

Quarter 1

MR3480	(4-1)	Atmospheric Thermodynamics and Radiative Processes
MR/OC3140	(3-2)	Probability and Statistics for Air-Ocean Science
MA1118	(5-2)	Multivariable Calculus
OC3230	(3-1)	Descriptive Physical Oceanography

Quarter 2

MA2047	(4-1)	Vector Analysis and Linear Algebra
MA2121	(4-0)	Differential Equations
MR/OC3321	(4-0)	Air-Ocean Fluid Dynamics
MR/OC3522	(4-2)	Remote Sensing of the Atmosphere and Ocean/Laboratory

Quarter 3

OC3260	(3-0)	Sound in the Ocean
OC3120	(3-2)	Biogeochemical Processes in the Ocean
MA3132	(4-0)	Partial Differential Equations and Integral Transforms
OC3240	(4-2)	Ocean Dynamics I

Quarter 4

OC4211	(4-0)	Ocean Dynamics II
OC3150	(3-2)	Analysis of Air-Ocean Time Series
OC4267	(4-3)	Ocean Influences and Prediction: Underwater Acoustics Elective
OC4XXX	(4-0)	Track Option

Quarter 5

MR/OC4413	(4-1)	Air-Sea Interaction
OC4900	(3-0)	Special Topics in Oceanography
MR/OC3570	(2-4)	Operational Oceanography and Meteorology
OC4XXX	(4-0)	Track Option

Quarter 6

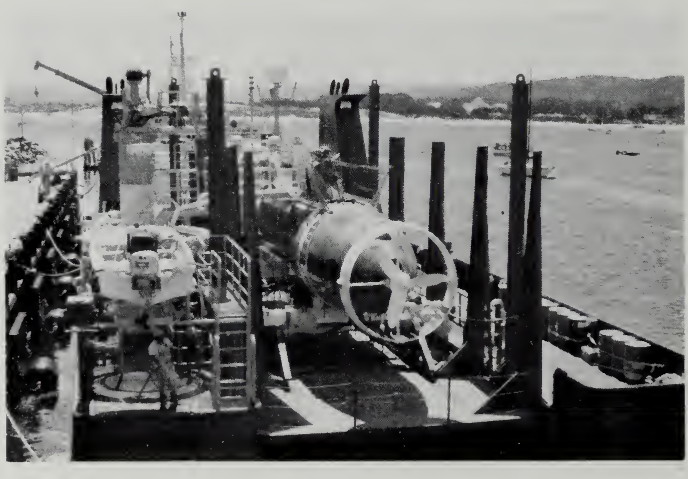
MR/OC3212	(4-0)	Polar Meteorology/Oceanography
MR/OC4323	(4-2)	Numerical Air and Ocean Modelling
OC4414	(3-0)	Advanced Air-Sea Interaction
OC0810		Thesis Research

Quarter 7

OC4213	(3-1)	Nearshore and Wave Processes
OC4XXX	(4-0)	Track Option
OC4XXX	(4-0)	Track Option
OC0810		Thesis Research

Quarter 8

OC4220	(3-2)	Coastal Oceanography
OC4XXX	(4-0)	Track Option
OC0810		Thesis Research
OC0999		Thesis Presentation



ANTISUBMARINE AND ELECTRONIC WARFARE PROGRAMS

ANTISUBMARINE WARFARE CURRICULUM 525

The ASW Curriculum educates officers in the engineering fundamentals, physical principals and analytical concepts that govern operational employment of ASW sensors and weapon systems and includes extensive breadth in the appropriate scientific and technical disciplines. This interdisciplinary program integrates mathematics, physics, acoustics, electrical engineering, oceanography, operations analysis, human factors, computer science and meteorology. The academic content divides naturally into four major areas: Electrical Engineering with emphasis on signal processing, Underwater Acoustics with emphasis on signal propagation and detection, Operations Analysis with emphasis on tactical application and decision analysis, and Air-Ocean Sciences with emphasis on the environmental factors affecting sound in the sea.

Curricular Officer:
Ken Williams
CDR, USN,
Code 3A, Spanagel Hall,
Room 304,
(408) 646-2135/6,
AV 878-2135/6.

REQUIREMENTS FOR ENTRY

A baccalaureate degree, or equivalent, from a program with a calculus sequence and a calculus-based physics sequence that results in an APC of 323 is required for direct input. Courses in the physical sciences and engineering are desirable. An additional qualification for entry is that a selectee must have demonstrated strong professional performance in at least one ASW mission unit. Officers not meeting the academic requirements for direct input enter the program via one or two quarters of Engineering Science (Curriculum 460).

ANTISUBMARINE WARFARE SUBSPECIALTY

Completion of this curriculum qualifies an officer as an Antisubmarine Warfare Subspecialist with a subspecialty code of XX44P. The Curriculum Sponsor is OP-71, Antisubmarine Warfare Division.

Typical Jobs in this Subspecialty:
Naval Ocean Systems Center
Naval Underwater Systems Center
Naval Surface Warfare Development Group
Destroyer Squadron Staffs
Operational Test and Evaluation Force
Submarine Development Squadron Twelve
Patrol Wing Staffs
Naval Air Systems Command
Air Test and Evaluation Squadron One
OPNAV

ENTRY DATES

The ASW curriculum is an eight-quarter course of study with entry dates in April and October. If further information is needed, contact the Academic Associate or Curricular Officer for this curriculum.

Curriculum 525
Academic Associate:
James V. Sanders, Assoc. Professor,
Code 33A, Spanagel Hall, Room 328,
(408) 646-2116, AV 878-2116.

DEGREE

Requirements for the degree Master of Science in Applied Science a met as a milestone en route to satisfying the skill requirements of t curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

MA2138	(5-0)	Multivariable Calculus, Ordinary Differential Equations and Laplace Transforms
MA2047	(4-1)	Linear Algebra and Vector Analysis
PH2401	(3-0)	Introduction to the Sonar Equations
OC3230	(4-0)	Oceanic Thermodynamic
OS2210	(4-1)	Introduction to Computer Programming

Quarter 2

EO2720	(4-2)	Electronic Systems
OS2103	(4-1)	Applied Probability for Systems Technology
PH2119	(4-2)	Oscillation and Waves
MA3139	(4-0)	Fourier Analysis and Partial Differential Equations

Quarter 3

EO3720	(4-1)	Introduction to Signals and Noise
OS3303	(4-1)	Computer Simulation
OS3604	(4-0)	Decision and Data Analysis
PH3402	(4-1)	Underwater Acoustics

Quarter 4

EO4720	(4-1)	Signal Processing Systems
OC4267	(4-3)	Ocean Influences and Predictions: Underwater Acoustics
OS3601	(4-0)	Search Detection and Localization
PH4403	(4-1)	Advanced Topics in Underwater Acoustics

Quarter 5

(First six weeks)

MR2413	(3-1)	Meteorology for Antisubmarine Warfare
OS3402	(3-1)	Human Factors for Antisubmarine Warfare
(Last six weeks)		Experience Tour Off Campus

Quarter 6

OS3602	(4-0)	C3 for Antisubmarine Warfare
PH3479	(3-0)	Physics of Underwater Weapons
OC3622	(3-2)	Tactical Oceanography
ST0810	(0-0)	Thesis Research

Quarter 7

OA4607	(3-2)	Tactical Decisions for Antisubmarine Warfare
OS4601	(4-0)	Test and Evaluation
NS3252	(4-0)	Joint and Maritime Strategic Planning
ST0810	(0-0)	Thesis Research

Quarter 8

PH3002	(4-0)	Non-Acoustic Sensor Systems
NS3152	(4-0)	Naval Warfare and the Threat Environment
ST0810	(0-0)	Thesis Research

LECTRONIC WARFARE
URRICULUM 595

is curriculum provides the services with officers thoroughly owledgeable in the technical and operational aspects of the role of ectronic warfare as a vital, integral part of modern warfare. It is signed to provide an understanding of the principles underlying the oad field of electronic warfare and because of the electronic nature modern sensor, weapon and command, control and communications stems, it seeks to develop in the officer a grasp of electronic, ectrical and electromagnetic fundamentals, theory and techniques.

EQUIREMENTS FOR ENTRY

udents wishing to undertake studies in this curriculum require a ccalaureate degree with above-average grades and completion of athematics courses through differential and integral calculus. ose lacking the background may matriculate via the Engineering ience Program (Curriculum 460). An APC of 325 is required for rect entry.

LECTRONIC WARFARE SUBSPECIALTY

mpletion of this curriculum qualifies an officer as an Electronic arfare Subspecialist with a code of XX46. The Curriculum Sponsor OP-76, Electronic Warfare Division.

pical Jobs in this Subspecialty:

aff Electronic Warfare: COM3RDFLT OPS CP
R: OPNAV OP-954H1
aff Electronic Warfare: CINCPACFLT
aff Electronic Warfare: COM7THFLT
ectronic Warfare Assistant: VAQ 33
ecutive Officer: NSGA, Naples/ECCM

NTRY DATE

is Electronic Warfare Curriculum is an eight-arter course of study with a single entry date in tober. If further information is needed, contact Academic Associate for this curriculum.

rriculum 595
ademic Associate:
ff Knorr, Professor,
de EC/Ko, Spanagel Hall, Room 428,
08) 646-2815, AV 878-2815.

PICAL COURSE OF STUDY

uarter 1

2450	(3-1)	Computer Programming with FORTRAN
A2138	(5-0)	Multivariable Calculus, Ordinary Differential Equations and Laplace Transforms
A2047	(4-1)	Linear Algebra and Vector Analysis
2203	(4-0)	Topics in Basic Physics: Waves and Optics

uarter 2

2720	(4-2)	Introduction to Electronic Systems
2103	(4-1)	Applied Probability for Systems Technology
A3139	(4-0)	Fourier Analysis and PDE
2600	(4-0)	Introduction to Fields and Waves

Quarter 3

EO2740	(4-1)	Introduction to Linear Systems
OS3604	(4-0)	Decision and Data Analys
EC2610	(3-1)	Electromagnetic Engineering
PH2207	(4-0)	Fundamentals of Electro-Optics

Quarter 4

EO4760	(4-1)	Microwave Devices and Radar
PH3208	(4-1)	Electro-Optics Principles and Devices
EO3720	(4-0)	Signal Processing System
EO3760	(4-2)	Electromagnetic Radiatio Scattering and Propagati

Quarter 5

MR2416	(2-0)	Meteorology for Electroni Warfare
OS3003	(4-0)	Operations Research for Electronic Warfare
(Last Six Weeks)		Experience Tour Off Campus

Quarter 6

EO4780	(3-2)	Electronic Warfare Systems
EO4730	(3-1)	Electro-Optic Systems and Countermeasures
EC2810	(3-2)	Digital Machines
EW0810	(0-0)	Thesis Research

Quarter 7

EO3780	(3-2)	Electronic Warfare Computer Applications
OS4601	(4-0)	Operational Test and Evaluation
EW0810	(0-0)	Thesis Research
EW0810	(0-0)	Thesis Research

Quarter 8

EO4740	(4-0)	Communication and Countermeasures
NS3252	(4-0)	Joint and Maritime Strategic Planning
NS3152	(4-0)	Naval Warfare and the Threat Environment
EW0810	(0-0)	Thesis Research

ELECTRONIC WARFARE (INTERNATIONAL) CURRICULUM 596

The curriculum is modeled after Curriculum 595 and for the first fo quarters exactly parallels the basic curriculum. In the second year, international students are channeled in courses similar in content t courses taught to U.S. students but without the classification level.

REQUIREMENTS FOR ENTRY

International students must meet the APC requirements and receiv approval by the Director of Admissions at the Naval Postgraduate School. Actual quota assignment and invitational travel orders are approved and issued by the Office of the Chief of Naval Operations through the Foreign Military Assistance Division.

YPICAL COURSE OF STUDY

uarter 1

S2450	(3-1)	Computer Programming with FORTRAN
A2138	(5-0)	Multivariable Calculus, Ordinary Differential Equations and LaPlace Transforms
A2047	(4-1)	Linear Algebra and Vector Analysis
H2203	(4-0)	Topics in Basic Physics: Waves and Optics

uarter 2

O2720	(4-2)	Introduction to Electronic Systems
S2103	(4-1)	Applied Probability for Systems Technology
A3139	(4-0)	Fourier Analysis and Partial Differential Equations
C2600	(4-0)	Introduction to Fields and Waves

uarter 3

O2740	(4-1)	Introduction to Linear Systems
S3604	(4-0)	Decision and Data Analysis
C2610	(3-1)	Electromagnetic Engineering
H2207	(4-0)	Fundamentals of Electro-Optics

uarter 4

O3720	(4-0)	Signal Processing Systems
H3208	(4-1)	Electro-Optic Principles and Devices
C2810	(3-2)	Digital Machines
C3600	(3-2)	Electromagnetic Radiation, Scattering and Propagation

uarter 5

C3610	(3-2)	Microwave Circuits
S3003	(4-0)	Operations Research for Electronic Warfare
S3303	(4-1)	Computer Simulation
R2416	(2-0)	Meteorology for Electronic Warfare

uarter 6

C4620	(3-2)	Radar Systems
C3620	(3-2)	Microwave Devices
H4209	(3-2)	EO/IR Systems and Countermeasures
W0810	(0-0)	Thesis Research

uarter 7

O3780	(3-2)	Electronic Warfare Computer Applications
S4601	(4-0)	Test and Evaluation
W0810	(0-0)	Thesis Research
W0810	(0-0)	Thesis Research

uarter 8

C4690	(3-2)	Principles of Electronic Warfare
		Elective
O4740	(4-0)	Communications and Countermeasures
W0810	(0-0)	Thesis Research

Curricular Officer:
Thomas J. Hoskins,
CDR, USN
Code 37, Spanagel Hall,
Room 401,
(408) 646-2174/5,
AV 878-2174/5.

COMPUTER SYSTEMS MANAGEMENT CURRICULUM 367

This is an interdisciplinary graduate-level master's program integrating mathematics, accounting, economics, statistics, computer science, information systems, behavioral science and management disciplines.

This program prepares the officer for the planning, procurement and management decision-making skills necessary to evaluate changing technology, to translate operational requirements and economic trade offs into system specifications and to implement and properly utilize complex tactical and non-tactical military computer centers, networks and systems. This curriculum is designed to meet the Navy's need for a technically qualified officer with managerial skills essential to the successful implementation and effective utilization of computer systems in military settings.

REQUIREMENTS FOR ENTRY

A baccalaureate degree, or the equivalent, with above-average grades in mathematics (including differential and integral calculus) resulting in an APC of at least 335 is required for direct entry. Students lacking these quantitative prerequisites may be acceptable for the program providing their undergraduate records and/or other indicators of success, such as GRE (Graduate Record Examination), GMAT (Graduate Management Admission Test) formerly ATGSB (Admission Test for Graduate Schools of Business), indicate a capability for graduate level work. While previous computer or automatic data processing (ADP) experience is certainly helpful, it is not essential.

COMPUTER SYSTEMS MANAGEMENT SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Computer Systems Management Subspecialist with a subspecialty code of XX95. The Curriculum Sponsor is OP-941, Director, Naval Communications/Information Systems Division.

Typical Jobs in this Subspecialty:
Weapons Control Project Subsurface
Service Engineer: Naval Underwater Systems Center, Newport, RI
Operation Test Evaluation: NAVELEX PDE-106 NAVSPACE PROGRAM, Washington, DC
Air Systems: NAVOCEANSYSCEN, San Diego, CA
Computer Systems: NSA/CSS, Ft. Meade, MD
Data Base Management: Naval War College, Newport, RI
Computer Systems Analyst/Development: COMNAVMEDCOM, Washington, DC
Computer Systems Analyst: COMNAVDAC, Washington, DC

ENTRY DATES

Computer Systems Management is a six-quarter course of study with entry dates in April and October. If further information is needed, contact the Academic Associate for this curriculum.

Curriculum 367
Academic Associate:
Daniel R. Dolk, Assistant Professor,
Code AS/DK, Ingersoll Hall, Room 316,
(408) 646-2260, AV 878-2260.

GREE

quirements for the degree Master of Science in Information stems are met as a milestone en route to satisfying the skill quirements of the curricular program.

PICAL COURSE OF STUDY

arter 1

2970	(4-1)	Structured Programming with ADA
2000	(3-0)	Introduction to Computer Management
N2155	(4-0)	Accounting for Management
N3105	(4-0)	Organization and Management

arter 2

3010	(4-0)	Computing Devices and Systems
3020	(4-0)	Software Design
3170	(4-0)	Economic Evaluation of Information Systems
3101	(5-0)	Statistical Analysis for Management

arter 3

3030	(4-0)	Operating Systems Structures
4200	(4-0)	Systems Analysis and Design
4183	(4-0)	Application of Database Management Systems
3004	(5-0)	Operations Research for Computer Systems Managers

arter 4

3502	(4-0)	Computer Networks: Wide Area/Local Area
4185	(4-0)	Decision Support Systems
0810	(0-0)	Thesis Research
3252	(4-0)	Joint and Maritime Strategic Planning
		Option Elective*

After 16 years in the Marine Corps, **Major (LtCol sel) Garry Lewis** has come to Monterey to receive his Master of Science in Computer Science. The 38-year-old Major already has an undergraduate degree in mathematics and a Master of Business Administration, but his interest in computers drove him back to school again.

"I chose to come to the Naval Postgraduate School because I really wanted to learn more about computers. Currently, I am very interested in object-oriented analysis and design, which is a relatively new concept. I would like to conduct my thesis research in this area."

Lewis thinks of his time spent at NPS as a very special duty assignment. "The education I am receiving is provided by the service, so that I can fill a billet requiring graduate level skill in computer science. What I am taught here will not only enable me to fulfill my responsibility to the Marine Corps, but it is also personally rewarding.

"NPS has an excellent program. I would encourage officers to attend graduate school earlier in their career. Don't wait, come to NPS while you still possess study habits developed during your undergraduate years. For officers that want to study the latest technology, I would strongly recommend NPS."

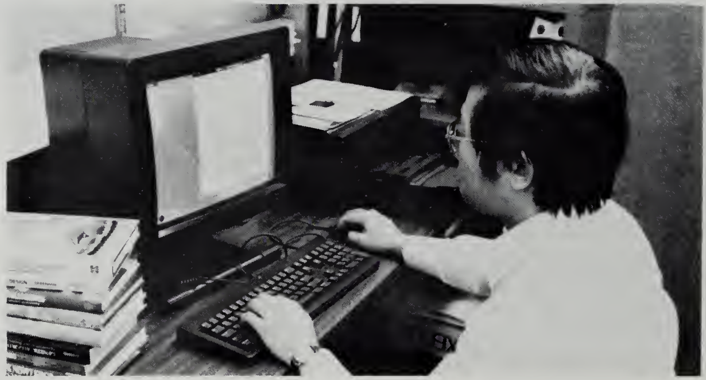
Quarter 5

IS4300	(4-0)	Software Engineering and Management
MN4154	(4-0)	Financial Management in the Armed Forces
IS0810	(0-0)	Thesis Research
		Option Elective*

Quarter 6

IS4182	(4-0)	Information Systems Management
MN3307	(4-0)	ADP Acquisition
IS0810	(0-0)	Thesis Research
		Option Elective*

*NOTE: The officer will use elective courses to complete an option area in one of the following: Decision Support System, Tactical Computers, Computer Networks and Information Resource Management.



COMPUTER SCIENCE CURRICULUM 368

This program is an interdisciplinary technical graduate-level master's program integrating mathematics, statistics, computer science, electrical engineering, information systems and operations research. The Computer Science curriculum is designed to provide an officer with the technical knowledge and skills necessary to specify, evaluate and manage computer system design; to provide technical guidance in applications ranging from data processing to tactical embedded systems; to educate officers in the analysis and design methodologies appropriate for hardware, software and firmware; and to provide the officer with practical experience in applying modern computer laboratory equipment and research techniques to military problems.

COMPUTER SCIENCE SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Computer Science Subspecialist with a subspecialty code of XX91. The Curriculum Sponsor is OP-941, Director, Naval Communications/ Information Systems Division.

ypical Jobs in this Subspecialty:
avigation Systems Integration
ojects Office: STRATSTSORIG, Washington, DC
sistant Information Management/TRIMIS ADDU FM
COMNAVMEDCOM, Washington, DC
DP Programs/WWMCCS: Project DPSCPAC, Pearl Harbor, HI
DP Plans Director: FLEMATSUPPO, Mechanicsburg, PA
DP Plans-Customer Liaison: NARDAC, Pensacola, FL
SST CIC-NTDS: USS CARL VINSON (CVN-70)

EQUIREMENTS FOR ENTRY

baccalaureate degree, or the equivalent, with above-average grades mathematics, (including differential and integral calculus) sulting in an APC of at least 325, is required for direct entry. ndergraduate majors in applied science or engineering are highly sirable. Students lacking these prerequisites may be acceptable for e program providing their undergraduate records and/or other dicators of success, such as GRE (Graduate Record Examination), dicate a capability to work in quantitative subjects. While previous ademic or practical experience in computer science is certainly lpful and can enhance an applicant's potential for admission, such perience is not a prerequisite.

NTRY DATES

omputer Science is an eight-quarter course of study with entry dates April and October. If further information is needed, contact the cademic Associate for this curriculum.

urriculum 368
cademic Associate:
no R. Kodres, Professor,
ode CS/Kr, Spanagel Hall, Room 534A,
08) 646-2197, AV 878-2197.

EGREE

equirements for the degree Master of Science in Computer Science e met as a milestone en route to satisfying the skill requirements of e curricular program.

YPICAL COURSE OF STUDY

uarter 1

S2970	(4-1)	Structured Programming in ADA
A2025	(4-1)	Logic, Sets and Functions
C2810	(3-2)	Digital Machines
S3001	(4-0)	Operations Research for Computer Scientists

uarter 2

S3200	(3-2)	Introduction to Computer Architecture
S3111	(4-0)	Principles of Programming Languages
S3300	(3-1)	Data Structures
A3026	(5-0)	Discrete Math and Automata Theory

uarter 3

S3320	(3-1)	Database Systems
S3310	(4-0)	Artificial Intelligence
S3450	(3-1)	Systems Software Design
S3460	(3-2)	Software Methodology

Quarter 4

CS3502	(4-0)	Computer Communications and Networks
CS3601	(4-0)	Theory of Algorithms
CS4900	(0-2)	Research Seminar in Computer Science I
		Option Elective*
		Option Elective*

Quarter 5

CS4550	(4-0)	Distributed Computing
CS4202	(3-2)	Computer Graphics
NS3252	(4-0)	Joint and Maritime Strategic Planning
		Option Elective*
CS4901	(0-2)	Research Seminar in Computer Science II

Quarter 6

CS3650	(4-0)	Theory of Formal Languages
		Option Elective*
		Option Elective*
CS0810	(0-0)	Thesis Research

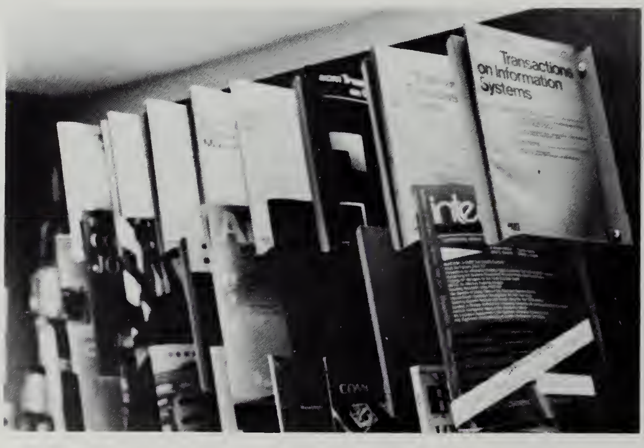
Quarter 7

CS4601	(4-0)	Computer Security
		Option Elective*
		Option Elective*
CS0810	(0-0)	Thesis Research

Quarter 8

		Option Elective*
		Option Elective*
CS0810	(0-0)	Thesis Research

*NOTE: Option Elective courses will be determined by the selection of one of the following tracks: Artificial Intelligence, Tactical Computer Systems, Military Data Processing or Software Engineering.



LECTRONICS AND COMMUNICATIONS PROGRAMS

LECTRONIC SYSTEMS ENGINEERING URRICULUM 590

his curriculum is designed to educate officers in current electronics chnology and its application to modern naval warfare. It stablishes a broad background of basic engineering knowledge, ading to selected advanced studies in electronic systems, ship/ eapon control systems, information processing applicability. It will nhance individual performance in all duties through a naval career, cluding operational billets, technical management assignments and olicy making positions, thereby preparing the officer for rogressively increased responsibility including command, both shore and afloat.

EQUIREMENTS FOR ENTRY

baccalaureate degree in engineering or the physical sciences is equired. Differential and integral calculus, one year of calculus-ased college physics and at least one semester of college chemistry re required. The Engineering Science Program (Curriculum 460) is vailable for candidates who do not meet all admission requirements. he additional time required will vary with the candidate's ackground. Prior to undertaking the program, or as a part of the rogram, each officer will have earned the equivalent of an accredited SEE. An APC of 323 is required for direct entry.

NTRY DATES

lectronic Systems Engineering is a nine-quarter course of study with ntry dates in every quarter. If further information is needed, ontact the Academic Associate or the Curricular Officer for this urriculum.

LECTRONICS AND COMMUNICATIONS SUBSPECIALTY

ompletion of this curriculum qualifies an officer as an Engineering lectronics Subspecialist with a subspecialty code XX55. The urriculum sponsor is Space and Naval Warfare Systems Command.

ypical Jobs in this Subspecialty:
nstructor: Naval Academy, Annapolis, MD
xecutive Officer: SPAWARHDQTRS
perations Test and Evaluation: COMOPTEVFOR
lectronics Maintenance Officer: USS NIMITZ CVN 68
xecutive Officer: NEEACT PAC, Pearl Harbor, HI
lectronics P and P: CINCLANTFLT
lectronics Maintenance Officer: USS BLUE RIDGE LCC 19
roject Officer: Warfare Systems Architecture and Engineering, SPAWARHDQTR

urriculum 590
cademic Associate:
ohn Powers, Professor,
ode EC/Po, Bullard Hall, Room 223,
08) 646-2679, AV 878-2679.

EGREE

equirements for the degree Master of Science in Electrical ngineering are met en route to satisfying the skill requirements of is curricular program.

Curricular Officer:
Rondel G. Reynolds,
CDR, USN,
Code 32, Spanagel Hall,
Room 404,
(408) 646-2056,
AV 878-2056.

TYPICAL COURSE OF STUDY

COMPUTER SCIENCE OPTION

Quarter 1

EC2100	(3-2)	Circuit Analysis I
EC2820	(3-2)	Digital Logic Circuits
MA2047	(4-0)	Linear Algebra and Vector Analysis
CS2450	(3-1)	Computer Programming with FORTRAN

Quarter 2

EC2110	(3-2)	Circuit Analysis II
EC2200	(3-3)	Electronics Engineering I
MA2121	(4-0)	Differential Equations
EC2600	(4-0)	Introduction to Fields and Waves

Quarter 3

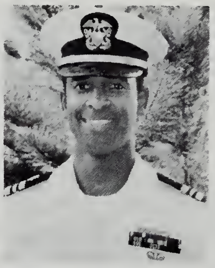
EC2800	(3-2)	Introduction to Microprocessors
EC2210	(3-2)	Electronics Engineering II
MA3232	(3-2)	Numerical Analysis
EC2410	(3-0)	Fourier Analysis of Signals and Systems

Quarter 4

EC3800	(3-2)	Microprocessor-Based Systems Design
EC2400	(3-0)	Discrete Signals and Systems
EC2420	(3-0)	Linear Systems
EC2500	(3-2)	Communications Theory

Quarter 5

EC3400	(3-0)	Digital Signal Processing
EC3820	(3-1)	Computer Systems
EC2300	(3-2)	Control Systems
EC2220	(2-4)	Applied Electronics



Lieutenant Commander Wayne Young views his time spent at NPS as a great way to keep abreast of military goings-on while pursuing a higher education. With an undergraduate degree from the Naval Academy in Management and Technology, Young came to NPS in 1989 to pursue a Masters Degree in Telecommunication Systems.

"In addition to seeking a Masters, I wanted to gain more knowledge in Surface Warfare, my specialty with the Navy." Young feels that his education at NPS will help open doors for jobs in the Navy that may have previously been closed to him.

One current project of Young's, involves compiling materials for a telecommunication systems instructional manual. The information he gathers will be used by students as a study aid and by graduates as a reference tool for Navy Telecommunications Systems and Networks.

Quarter 6

EC2610	(3-2)	Electromagnetic Engineering
EC3830	(3-2)	Digital Computer Design Methodology
OS2102	(4-1)	Introduction to Applied Probability for Electrical Engineering
EC0810	(0-0)	Thesis Research

Quarter 7

EC3600	(3-2)	Electromagnetic Radiation, Scattering and Propagation
CS2970	(4-1)	Structured Programming with ADA
EC3500	(4-0)	Analysis of Random Signals
EC0810	(0-0)	Thesis Research

Quarter 8

EC4830	(3-1)	Digital Computer Design
EC4820	(3-1)	Computer Architectures
EC0810	(0-0)	Thesis Research
EC0810	(0-0)	Thesis Research

Quarter 9

EC4460	(3-0)	Principles of Systems Engineering
CS4500	(4-1)	Software Engineering
EC4870	(3-2)	VLSI Systems Design
EC0810	(0-0)	Thesis Research

COMMUNICATIONS ENGINEERING CURRICULUM 600

The curriculum will provide officers with a comprehensive scientific and technical knowledge in the field of communications engineering as applied to Navy and Defense command, control and communication systems. It is designed to establish a broad background of basic engineering knowledge, leading to the selected advanced studies in communications. The officer student is provided a sound academic background in mathematics, computer science and technology, physics and electrical engineering. Additionally, the subject areas of digital signal processing, analysis of random signals, radiation, scattering and propagation and microprocessor-based systems design are ncluded.

REQUIREMENTS FOR ENTRY

A baccalaureate degree, or its equivalent, in engineering or the physical sciences is preferred and at least one semester of college chemistry is required. The Engineering Science Program (Curriculum 460) is available for candidates who do not meet all admission requirements. The additional time required will vary with the candidate's background. Prior to undertaking the program, or as part of the program, each officer will have earned the equivalent of an accredited BSEE. An APC of 323 is required for direct entry.

COMMUNICATIONS ENGINEERING SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Communications Engineering Specialist with a code of XX81. The curriculum sponsor is OP-941, Naval Communications Division.

Typical Jobs in this Subspecialty:

Communications Engineering: DEFCOMMENGCEN, Washington, D
TACAMO Project Control: SPAWAR
Command Assistant for Electromagnetic Spectrum Management
CINCPACFLT
Decision and Control: NOSC, San Diego, CA
Assistant for FLTSATCOM/UH: OPNAV OP-943C2
Assistant for MILSTAR/EXT: OPNAV OP-943C4
MILAST/ADUSD: Office of Secretary of Defense
SR TELECOMM: NSA/CSS, Ft. Meade, MD
Signal Analyst: NSA/CSS, Ft Meade, MD
Plans and Projects: COMNAVSECGRU, Washington, DC

Curriculum 600
Academic Associate:
Tri T. Ha, Professor,
Code EC/Ha, Spanagel Hall, Room 426,
(408) 646-2788, AV 878-2788.

DEGREE

Requirements for the degree Master of Science in Electrical Engineering are met as a milestone en route to satisfying the skill requirements of this curricular program.

ENTRY DATES

Communications Engineering is a nine-quarter course of study with entry dates in January, April, July and October. If further information is needed, contact the Academic Associate or the Curricular Officer for this curriculum.

TYPICAL COURSE OF STUDY

Quarter 1

EC2100	(3-2)	Circuit Analysis I
EC2820	(3-2)	Digital Logic Circuits
MA2047	(4-0)	Linear Algebra and Vector Analysis
CS2970	(4-1)	Structured Programming with ADA

Quarter 2

EC2110	(3-2)	Circuit Analysis II
EC2200	(2-4)	Electronics Engineering I
MA2121	(4-0)	Differential Equations
EC3830	(3-2)	Digital Computer Design Methodology

Quarter 3

EC2410	(3-0)	Fourier Analysis of Signals and Systems
EC2210	(3-2)	Electronics Engineering II
MA3232	(3-2)	Numerical Analysis
EC2400	(3-0)	Discrete Systems and Systems

Quarter 4

EC2500	(3-2)	Communications Theory
EC2420	(3-0)	Linear Systems
OS2102	(4-1)	Introduction to Applied Probability for Electrical Engineering
EC2600	(4-0)	Introduction to Fields and Waves

Quarter 5

EC2300	(3-2)	Control Systems
EC2220	(2-4)	Applied Electronics
EC3500	(4-0)	Analysis of Random Signals
EC2610	(3-2)	Electromagnetic Engineering

Quarter 6

EC3400	(3-0)	Introduction to Digital Signal Processing
EC4590	(3-0)	Communication Satellite Systems Engineering
EC3510	(3-0)	Communications Engineering
EC3600	(3-2)	Electromagnetic Radiation, Scattering and Propagation

Quarter 7

EC2800	(3-2)	Introduction to Microprocessors
EC4560	(3-2)	Communications ECCM
MN3301	(4-0)	Systems Acquisition and Project Management
EC0810	(0-0)	Thesis Research

Quarter 8

EC3800	(3-2)	Microprocessor-Based System Design
EC4550	(4-0)	Digital Communications
EC0810	(0-0)	Thesis Research
EC0810	(0-0)	Thesis Research

Quarter 9

CM3112	(4-0)	Navy Telecommunication Systems
EC3550	(3-1)	Fiber Optic Systems Fundamentals Elective
EC0810	(0-0)	Thesis Research

TELECOMMUNICATIONS SYSTEMS MANAGEMENT CURRICULUM 620 AND 620 CG

This curriculum provides instruction to officers who will perform as communications managers of new communication systems applications or as communication officers in large commands and staffs, afloat and ashore, including the organization of the Joint Chief of Staff and the Defense Communications Agency. The 620 and 620CG curricula are sponsored respectively by the Director of Naval Communications and the U.S. Coast Guard Headquarters. Each curriculum provides comprehensive study in management, with emphasis on the systems management field. Additionally, the curricula provides study in the technical field appropriate to decision making in advanced systems and program management. These technical courses within the 620 curriculum have been especially prepared for non-engineers, whereas those in the 620CG curriculum are engineering courses.

TELECOMMUNICATIONS SYSTEMS MANAGEMENT SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Telecommunications Systems Management Subspecialist with a code of XX82. The curriculum sponsor is OP-941, Naval Communications Division.

Typical Jobs in this Subspecialty:
COMM AF: USS JOHN F. KENNEDY CV 67
Commanding Officer: NAVCOMSTA, Thurso, UK
Commanding Officer: NAVCOMSTA, Jacksonville, FL
COMM OPS/FLT COMM: CINCUSNAVEUR
OPS T and E: SPAWAR PDE-120
Staff COMM 84/10: EUCOM US HDQTRS
PACAREA SI COMM: CINCPACFLT SECGRP
COMM AF: USS BLUE RIDGE LCC 19

REQUIREMENTS FOR ENTRY

Undertaking studies in this curriculum requires a baccalaureate degree with above-average grades and completion of mathematics courses through single variable calculus. An APC of 335 is required for direct entry.

DEGREE

Requirements for the degree Master of Science in Telecommunications Systems Management are met as a milestone en route to satisfying the skill requirements of the curricular program.

ENTRY DATE

Telecommunications Systems Management is a six-quarter course of study with a single entry date in August for technical refresher. The 620CG curriculum is eight quarters in length and convenes in July. If further information is needed, contact the Academic Associate or the Curricular Officer for these curricula.

Curricula 620 and 620CG
Academic Associate:
Dan C. Boger, Associate Professor,
Code AS/Bo, Ingersoll Hall, Room 241,
(408) 646-2607, AV 878-2607.

TYPICAL COURSE OF STUDY

STANDARD OPTION

Refresher Period

MA0112	(5-5)	Calculus
CM3111	(3-0)	C3 Mission and Organization

Quarter 1 (October)

CS2970	(5-0)	PASCAL
MN2155	(4-0)	Accounting for Management
MN3105	(4-0)	Organization and Management
MN3301	(4-0)	Systems Acquisition
CM0001	(0-2)	Seminar

Quarter 2

CS3050	(4-0)	Software Engineering
MA1248	(4-1)	Applied Mathematics
OS3104	(4-0)	Statistics
CM0001	(0-2)	Seminar

Quarter 3

OS3404	(3-0)	Man-Machine Interaction
EO2710	(3-2)	Signal and Systems I
CM3112	(4-0)	Naval Telecommunications Systems
OS3005	(4-0)	Operations Research for Communications Managers
CM0001	(0-2)	Seminar
		Two Week Experience Tour

Quarter 4

MN4125	(4-0)	Managing Planned Change in Complex Organizations
EO2750	(3-2)	Signals and Systems II
IS3502	(4-0)	Computer Networks
CM3001	(4-0)	Economic Evaluation of Telecommunications
CM0001	(0-2)	Seminar

Quarter 5

CM0810	(0-0)	Thesis Research
EO3750	(4-1)	Communications Systems Analysis
CM4502	(4-0)	Telecommunications Networks
CM3002	(4-0)	Economic Evaluation of Telecommunications
CM0001	(0-2)	Seminar

Quarter 6

CM0810	(0-0)	Thesis Research
CM4925	(4-0)	Telecommunications Systems, Industry and Regulations
MN/IS/CM/OS		Elective
CM0001	(0-2)	Seminar

COAST GUARD OPTION

Quarter 1 (July)

EC2170	(4-2)	Introduction to Electrical Engineering
MA1116	(5-0)	Multivariable Calculus
CS2950	(5-0)	Structure Programming with FORTRAN
MN3105	(4-0)	Organization and Management

Quarter 2

EC2110	(3-2)	Circuit Analysis II
MA2049	(4-0)	Applied Mathematics for Engineering and Operations Analysis
OS3404	(3-0)	Man-Machine Interactions
MN2155	(4-0)	Accounting for Management

Quarter 3

EC2720	(4-2)	Introduction to Electronics Systems
CS3010	(4-0)	Computing Devices and Systems
OS3101	(5-0)	Statistic Analysis for Management
MN4125	(4-0)	Managing Planned Change in Complex Organizations

Quarter 4

EI3720	(4-1)	Introduction to Signals and Noise
OS3005	(4-0)	Operations Research for Communications Managers
CM3112	(4-0)	Navy Telecommunication Systems
CM3111	(4-0)	C3 Mission and Organization

Quarter 5

CS3020	(3-2)	Software Design
IS3502	(4-0)	Computer Networks: Wide Area / Local Area
CM3001	(4-0)	Economic Evaluation of Telecommunications Systems I

Quarter 6

EO3750	(3-1)	Communication Systems Analysis
CS3030	(4-0)	Operating Systems Structure
CM3002	(4-0)	Economic Evaluation of Telecommunication Systems II
CM0810	(0-0)	Thesis Research

Quarter 7

CM4925	(4-0)	Telecommunication Systems, Industry and Regulations
CM0810	(0-0)	Thesis Research

Quarter 8

EC2250	(4-2)	Accelerated Review of Electronic Engineering
MN3301	(4-0)	Systems Acquisition and Project Management
CM0810	(0-0)	Thesis Research

OINT COMMAND, CONTROL AND COMMUNICATIONS (C3) AND SPACE SYSTEMS PROGRAMS

OINT COMMAND, CONTROL AND COMMUNICATIONS (C3) URRICULUM 365

Curricular Officer:
Robert A. Allen,
LTCOL, USAF,
Code 39, Spanagel Hall,
Room 203,
(408) 646-2772,
AV 878-2772.

he Joint C3 curriculum is designed to meet broad educational bjectives endorsed by the Joint Chiefs of Staff. The overall objective to provide officers and DOD civilian equivalents, through graduate ducation, a comprehensive operational and technical understanding the field of Command, Control and Communications systems as pplied to joint and combined military operations at the national and nified command levels. The program is designed with the following oals: to enable individuals to develop an understanding of the role 3 systems play in the use of military power and the ability to nterpret the impact of C3 on operating philosophy; to provide dequate background knowledge in the basic technology, human apabilities and joint military operations and how these factors are xploited in current C3 systems; and, to provide the framework hereby students can perform requirement and planning studies of ew C3 systems and contribute to crisis management.

hese officers should be able to undertake a wide range of ssignments in C3 (both joint and intra-service) over the full span of heir career.

EQUIREMENTS FOR ENTRY

he Joint C3 curriculum is open to all U.S. Military Services and elected civilian employees of the U.S. Federal Government. dmission requires a baccalaureate degree with above-average rades and mathematics through differential and integral calculus. TOP SECRET security clearance is required with SPECIAL NTELLIGENCE (SI) clearance obtainable. An APC of 325 is equired for direct entry. Officers not meeting the academic equirements for direct input may enter the program via one or two uarters of Engineering Science (Curriculum 460).

OINT COMMAND, CONTROL AND COMMUNICATIONS (C3) UBSPECIALTY

ompletion of this curriculum qualifies an officer as a Joint ommand, Control and Communications (C3) Subspecialist with a ubspecialty code of XX45P. The curriculum sponsor is the irectorate for Command, Control and Communications Systems J6), Joint Staff.

ypical Jobs in this Subspecialty:

taff Command and Control Officer:
 Commander in Chief, Pacific Fleet
urface Systems Officer: Naval Ocean Systems Center
DP Plans Officer: World Wide Military Command and Control
 System Joint Program Office
taff Operations Plans Officer: Headquarters, European Command
taff Operations and Plans Officer: Commander 7th Fleet
rograms Manager: Naval Space and Warfare Systems Command

NTRY DATES

oint Command, Control and Communications (C3) is a six-quarter ourse of study with a single entry date in October. If further nformation is needed, contact the Academic Associate or the urricular Officer for this curriculum.

Curriculum 365
Academic Associate:
Dan C. Boger, Professor,
Code AS/Bo, Ingersoll Hall, Room 241,
(408) 646-2607, AV 878-2607.

DEGREE

Requirements for the degree Master of Science in Systems Technolo [Joint Command, Control and Communications (C3)] are met as a milestone en route to satisfying the skill requirements of the curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

CS3010	(4-0)	Computing Devices and Systems
OS3404	(3-0)	Man-Machine Interaction
OS2103	(4-1)	Applied Probability for Systems Technology
CC3000	(4-0)	Introduction to Command, Control and Communications

Quarter 2

MA1248	(4-1)	Selected Topics in Applied Mathematics for C3, Space Operations and Communications Management
OS3008	(4-0)	Analytical Planning Methodology
CC3001	(4-0)	Combat and C3 Modeling
OS3604	(4-0)	Decision and Data Analysis

Quarter 3

OS3603	(3-1)	Simulation and Wargaming
EO2710	(4-2)	Introduction to Signals and Systems
IS4320	(4-0)	Data Base Systems and Information Resource Management
CC4001	(4-0)	C3 Systems: Structure, Process, Dynamics

Quarter 4

XX3XXX	(4-0)	Emphasis Elective
EO2750	(4-2)	Communications Systems
MN3301	(4-0)	Systems Acquisitions and Project Management
MR2419	(2-0)	Atmospheric Factors in C3
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 5

EO3750	(3-1)	Communications Systems Analysis
CC0810	(0-0)	Thesis Research
CC4003	(2-4)	C3 Systems Engineering
XX3XXX	(4-0)	Emphasis Elective

Quarter 6

CC4004	(4-0)	C3 Policies and Problems
CC0810	(0-0)	Thesis Research
XX3XXX or XX4XXX	(4-0)	Emphasis Elective

PACE SYSTEMS OPERATIONS
URRICULUM 366

ie Space Systems Operations graduate curriculum is designed to rovide officers with an appreciation for military opportunities and pplications in space, comprehensive, practical, as well as theoretical iowledge of the operation, tasking and employment of space irveillance, communications, navigation and atmospheric/ eanographic/ environmental sensing systems and a knowledge of iyload design and integration.

NTRY DATES

pace Systems Operations is an eight-quarter course of study with a ngle entry date in October. If further information is needed, contact e Academic Associate or the Curricular Officer for this curriculum.

PACE SYSTEMS OPERATIONS UBSPECIALTY

ompletion of this curriculum qualifies an ficer as a Space Systems Operations ıbspecialist with a subspecialty code of X76. The curriculum sponsor is OP-943, avy Space Systems Division.

ypical Jobs in this Subspecialty:
ommanding Officer: Naval Space
 Surveillance Systems
lans Officer: North American Aerospace
 Defense Command
dvanced Concepts Officer: Naval Space and
 Warfare Systems Command
pace Defense Director: North American
 Aerospace Defense Command

EQUIREMENTS FOR ENTRY

his curriculum is open solely to officers of the U.S. Armed Forces ıd selected civilian employees of the U.S Federal Government. dmission requires a baccalaureate degree with above-average ades, completion of mathematics through differential and integral ılculus, plus at least one course in calculus-based engineering hysics. Students lacking this background may matriculate through ıe Engineering Science program (Curriculum 460). A TOP SECRET ecurity clearance is required with SPECIAL INTELLIGENCE (SI) earance obtainable.

urriculum 366
cademic Associate:
an C. Boger, Professor,
ode AS/Bo, Ingersoll Hall, Room 241,
08) 646-2607, AV 878-2607.

EGREE

equirements for the degree Master of Science in Systems Technology pace Operations) are met as a milestone en route to satisfying the kill requirements of the curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

SS2001	(4-0)	Introduction to Space
MA1118	(5-2)	Multivariable Calculus
CS2970	(5-0)	Structural Programming with ADA
OS2103	(4-1)	Applied Probabilty for Systems Technology

Quarter 2

PH1322	(4-1)	Electricity and Magnetism
MA1248	(4-1)	Selected Topics in Applied Mathematics for C3, Space Operations and Communications Management
CS3020	(3-2)	Software Design
OS3604	(4-0)	Decision and Data Analysis

Quarter 3

PH2511	(4-0)	Introduction to Space Mechanics
CM3111	(4-0)	C3 Mission and Organization
EO2710	(4-2)	Introduction to Signals and Systems
OS3008	(4-0)	Analytical Planning Methodology

Quarter 4

SS3001	(4-0)	Military Applications of Space
PH3514	(4-0)	Introduction to the Space Environment
EO2750	(4-2)	Communications Systems
OS3601	(4-0)	Search and Detection Theory

Quarter 5

SS4001	(4-0)	Decisions and Space Systems
MN3301	(4-0)	Systems Acquisition
EO3750	(3-1)	Communications Systems Analy
OS3603	(3-1)	Simulation and Wargaming

Quarter 6

AE4830	(3-2)	Spacecraft Systems I
MR3522	(4-2)	Remote Sensing
SS0810	(0-0)	Thesis Research
XXXXXX		Emphasis Area

Quarter 7

AE4831	(4-0)	Spacecraft Systems II
NS3252	(4-0)	Joint and Maritime Strategic Planning
SS0810	(0-0)	Thesis Research
XXXXXX		Emphasis Area

Quarter 8

SS4002	(4-0)	Development in Space Naval Warfare
SS0810	(0-0)	Thesis Research
SS0810	(0-0)	Thesis Research
XXXXXX		Emphasis Area

SPACE SYSTEMS ENGINEERING CURRICULUM 591

To provide officers, through graduate education, with a comprehensive scientific and technical knowledge of military and Navy space systems. This curriculum is designed to equip officers

n the theoretical and practical skills required to design and
grate military space payloads with other spacecraft subsystems.
cer graduates will be prepared by their education to design,
elop and manage the acquisition of space communications,
igation, surveillance, electronic warfare and environmental
sing systems.

QUIREMENTS FOR ENTRY

accalaureate degree, or its equivalent, in engineering or the
sical sciences is preferred. The Engineering Science program
rriculum 460) is available for candidates who do not meet all
ission requirements. The additional time required will vary with
candidate's background. For those undertaking the electrical
ineering program, the officer will have earned the equivalent of an
edited BSEE. An APC of 323 is required for direct entry. A TOP
URITY clearance is required with SPECIAL INTELLIGENCE (SI)
rance obtainable.

TRY DATES

ce Systems Engineering is a nine-quarter course of study with
ry dates in April and October. If further information is needed,
tact the Academic Associate or the Curricular Officer for this
riculum.

rriculum 591
demic Associate:
o Heinz, Professor,
e PH/Hz, Spanagel Hall, Room 114,
) 646-2121, AV 878-2121.

GREE

uirements for one of seven technical degrees are met as a
estone en route to satisfying the skill requirements of this
ricular program. The possible degrees are: Master of Science in
ineering Science, Computer Science, Electrical Engineering,
hanical Engineering, Physics, Aeronautical Engineering or
ronautical Engineering.

ACE SYSTEMS ENGINEERING SUBSPECIALTY

npletion of this curriculum qualifies an officer as a Space Systems
ineering Specialist with a subspecialty code of XX77. The
riculum sponsor is OP-943, Navy Space Systems Division.

pical Jobs in this Subspecialty:
istant Project Manager Satellite Communications: SPAWAR
nager: Navy Space Project SPAWAR
ad DMSP and NAVDEP: Joint Program Office Navy Space Systems
ctivity, Los Angeles, CA
istant for Navigation Systems: CNO OP-943DI
LSTAR Systems Engineering: Navy Space Systems Activity,
os Angeles, CA
ad Satellite Surveillance: CNO OP-986E
nch and Control Systems Officer: Naval Space Command
istant for TENCAP Systems: OP-943E11
ns and Project Officer: Naval Space Surveillance Systems
ctronics Engineering Systems
partment Head: Navy Astronautics Group, Pt. Mugu, CA

TYPICAL COURSE OF STUDY

Quarter 1

MA2121	(4-0)	Differential Equations
SS2001	(4-0)	Introduction to Space
EC2820	(3-2)	Digital Logic
CS2450	(3-1)	Computer Programming with FORTRAN

Quarter 2

EC2420	(3-0)	Linear Systems
PH2511	(4-0)	Orbital Mechanics
EC2410	(3-0)	Fourier Analysis
EC2200	(3-3)	Electronics I

Quarter 3

EC2400	(3-0)	Discrete Systems
AE2820	(3-2)	Introduction to Spacecraft Structures
EC2500	(3-2)	Communications Theory
EC2210	(3-2)	Electronics II

Quarter 4

EC2300	(3-2)	Controls
PH3514	(4-0)	Space Environment
EC2800	(3-2)	Microprocessors
AE2840	(3-2)	Thermo-fluids

Quarter 5

SS3001	(4-0)	Military Operations in Space
EO3740	(4-0)	Space Power
EC2220	(2-4)	Applied Electronics
AE3815	(4-0)	Introduction to Spacecraft Dynamics

Quarter 6

NS3252	(4-0)	Joint and Maritime Strategic Planning
MR3522	(4-2)	Remote Sensing
AE3850	(4-0)	Propulsion
XXXXXX		Specialization Sequence

Quarter 7

PH3360	(4-1)	Electromagnetic Wave Propagation
AE0810	(0-0)	Thesis Research
AE3804	(3-0)	Thermal Control
XXXXXX		Specialization Sequence

Quarter 8

AE0810	(0-0)	Thesis Research
AE4870	(4-0)	Spacecraft Design and Integration
XXXXXX		Specialization Sequence
XXXXXX		Specialization Sequence

Quarter 9

MN3301	(4-0)	Project Management
SS0810	(0-0)	Thesis Research
SS0810	(0-0)	Thesis Research
XXXXXX		Specialization Sequence

ATIONAL SECURITY AND INTELLIGENCE PROGRAMS

EA STUDIES
RRICULA 681-684

a studies curricula focus on the history, culture and religion of a ific region or country and provide students with a knowledge of ent issues, economic and political structures and institutions, itary forces, including strategic capabilities and policy lications and geopolitical influences.

QUIREMENTS FOR ENTRY

pective students must be officers or civilian employees of the U.S. eral Government or allied nations. Students must have a alaureate degree earned with above-average academic ormance and an APC of 365. Foreign military officers must have CL proficiency rating of 80 or better to be admitted. College l preparation in basic descriptive and inferential statistics is uired.

TRY DATES

a studies are six-quarter courses of study with entry dates in uary and July. If further information is needed, contact the demic Associate or the Curricular Officer for this curriculum.

ricula 681-684
demic Associate:
Tsypkin, Associate Professor
e NS/Ts, Root Hall, Room 100
)646-2218/2521, AV 878-2218/2521

GREE

uirements for the degree of Master of Arts in National Security irs are met en route to satisfying the skill requirements of the icular program.

EAST, AFRICA, SOUTH ASIA SUBSPECIALTY

pletion of the 681 curriculum qualifies an officer as a Mid East, ca, South Asia Subspecialist with a subspecialty code of XX21. curriculum sponsor is OP-06, Chief of Naval Operations (Plans, cy and Operations).

ical Jobs in this Subspecialty:

rations Intelligence: Commander Middle East Force
Operations and Plans: Commander Middle East for Bahrain
-MIL Planner: Joint Chiefs of Staff, Washington, DC
East/Southwest Asia Policy: CINCUSNAVEUR LONDON
a Officer: DIA
d, Middle East, Asia, Southwest Asia: OP-611
itary Assistance Program: Military Liaison Office Tunisia

R EAST, SOUTHEAST ASIA, PACIFIC SUBSPECIALTY

pletion of the 682 curriculum qualifies an officer as a Far East, theast Asia, Pacific Subspecialist with a subspecialty code of 2. The curriculum sponsor is OP-06, Chief of Naval Operations ns, Policy and Operations).

Curricular Officer:
Terry W. Tiernay, CDR, USN,
Code 38, Root Hall, Room 216,
(408) 646-2228, AV 878-2228.

Assistant Curricular Officer (SSO):
Mary L. Rhodes,LT, USN,
Code 381, Root Hall, Room 211,
(408) 646-2845, AV 878-2845.

Typical Jobs in this Subspecialty:
Chief of Staff: COMNAVBASE GUAM
Staff Negotiations Representative: USCINCPAC REP PHILIPPIN
Staff Operations and Plans: CINCPACFLT
Faculty Member: DIC
OP-635C Assistant for Military Sales: OPNAV-FOREIGN MILITA
Analyst: OPNAVSUPPACT, Washington, DC

WESTERN HEMISPHERE SUBSPECIALTY

Completion of the 683 curriculum qualifies an officer as a Wester Hemisphere Subspecialist with a subspecialty code of XX23. The curriculum sponsor is OP-06, Chief of Naval Operations (Plans, P and Operations).

Typical Jobs in this Subspecialty:
Political Military Planner: Joint Chiefs of Staff
Executive Assistant: Inter American Defense
Air Antisubmarine Warfare/Plans: COMSOLANTFOR
Strategy and Policy Central and South Atlantic: USCINCLANT
Intelligence Analyst: USCINSCO
Area Officer: DIA
OP-613B1 CUBA/CARIBBEAN: OPNAV
Assistant for Military Sale: OPNAV-FOREIGN MILITARY
CTRY Director: Office of Secretary of Defense
OP-613 Assistant Branch Head: South America

EUROPE AND USSR SUBSPECIALTY

Completion of the 684 curriculum qualifies an officer as a Europe/ USSR Subspecialist with a subspecialty code of XX24. The curriculum sponsor is OP-06, Chief of Naval Operations (Plans, Policy and Operations).

Typical Jobs in this Subspecialty:
Staff Plan: NATO
ACOS for Plans: SACLANT
POL-MIL Planner: Joint Chiefs of Staff
Geopolitical Intelligence Office: CINCUSNAVEUR LONDON
Atlantic Allied Plans: COMINEWARCOM

STRATEGIC PLANNING AND INTERNATIONAL ORGANIZATIONS AND NEGOTIATIONS
CURRICULUM 688

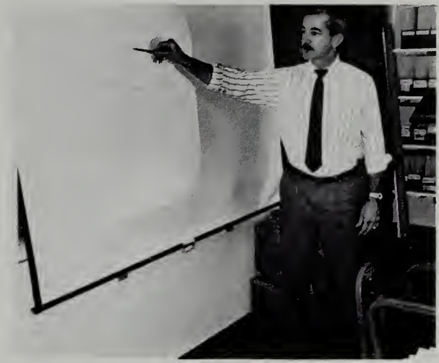
This curriculum combines three previously separate curricula: 684- International Organizations and Negotiations, 686-Strategic Plann (General) and 687-Strategic Planning (Nuclear). This new, combin curriculum is designed to provide students with a wide knowledge thorough understanding of the complex, interrelated variables in b the domestic and international environments when evaluating strategic planning options and supportive negotiating positions in t formulation of U.S. national security policy.

REQUIREMENTS FOR ENTRY

Entrance is open to officers and civilian employees of the U.S. Fede Government eligible for a TOP SECRET clearance with access to Sensitive Compartmented Information based on a Special Backgrou Investigation completed within the past five years. A baccalaureate degree earned with above-average academic performance and a minimum APC of 335 are required.

NTRY DATES

trategic Planning and International Organizations and Negotiations an eight-quarter course of study with entry dates in January and uly. If further information is needed, contact the Academic ssociate or the Curricular Officer for this urriculum.



urriculum 688
cademic Associate:
rank M. Teti, Associate Professor,
ode NS/Tt, Root Hall, Room 201,
08) 646-2528/2521, AV 878-2528/2521.

TRATEGIC PLANNING AND NTERNATIONAL ORGANIZATIONS AND EGOTIATIONS SUBSPECIALTY

ompletion of the 688 curriculum qualifies an fficer as a Strategic Planning and International rganizations and Negotiations Subspecialist with subspecialty code of XX28. The curriculum ponsor is OP-06, Chief of Naval Operations lans, Policy and Operations).

ypical Jobs in this Subspecialty:
epresentative for International Negotiations: Joint Chiefs of Staff
ilitary Assistant: U.S. Arms Control and Disarmament
ssistant for Nuclear Negotiations: OPNAV
ead Trident Strategic Weapons: OPNAV
SBN Current Operations: USCINCLANT
ar Plans: CINCUSNAVEUR

EGREE

equirements for the degree Master of Arts in National Security ffairs are met en route to satisfying the skill requirements of the rricular program.

TELLIGENCE URRICULUM 825

his curriculum consists of three emphasis tracks: Track 1 - cientific and Technical Intelligence, Track 2 - Soviet Studies- telligence and Track 3 - Operational Intelligence (OPINTEL). tudents in the intelligence curricula will gain a thorough nderstanding of the U.S. Intelligence Community and its current nd future operations; a general understanding of the scientific and chnical factors which bear on intelligence and a general nderstanding of the use of computers in intelligence; and a general nderstanding of the Soviet Union and the role of its military, articularly the Soviet Navy. The foregoing will be used as a basis r students as they pursue coursework in one of the three emphasis acks of intelligence. Two other broad study areas round out each rricula: analysis and management, and national security affairs. he analysis and management sequence provides a grounding in antitative techniques and research methods. National Security ffairs courses address the interface between international politics nd national security objectives.

REQUIREMENTS FOR ENTRY

Prospective students must be U.S. military officers or civilian employees of the U.S. Federal Government eligible for a TOP SECRE clearance with access to Sensitive Compartmented Information based on a Special Background Investigation completed within the past five years. They must have a baccalaureate degree earned with above-average academic performance and a minimum APC of 334 (Track 1), 365 (Track 2), or 265 (Track 3). Track 2 is limited to 1630 designated officers only. A similar course of study (without heavy intelligence emphasis) is available for other designators within the National Security Affairs studies curriculum 683.

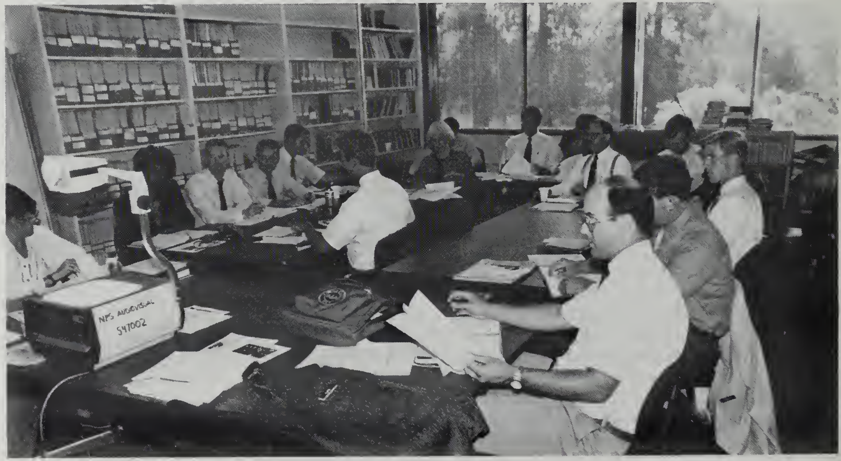
ENTRY DATES

Scientific and Technical Intelligence is a six-quarter course of study with a starting date in April. In addition, all students will report for a math and physics refresher in mid-February. Soviet Studies Intelligence is an eight-quarter program with a starting date of July. Operational Intelligence is either a four-quarter (1630 and USMC) or five-quarter (other designators) program with a starting date of July. If further information is needed, contact the Academic Associate or the Curricular Officer for this curriculum.

INTELLIGENCE SUBSPECIALTY

Completion of any of the three curricula qualifies an officer as an Intelligence Subspecialist with one of the following subspecialty codes:

Track 1 - Scientific and Technical	XX17
Track 2 - Soviet Studies	XX18 (proposed)
Track 3 - OPINTEL	XX19 (proposed)



EQUIREMENTS FOR ENTRY

rospective students must be U.S. military officers or civilian nployees of the U.S. Federal Government eligible for a TOP SECRET earance with access to Sensitive Compartmented Information based a Special Background Investigation completed within the past five ars. They must have a baccalaureate degree earned with above-erage academic performance and a minimum APC of 334 (Track 1), 5 (Track 2), or 265 (Track 3). Track 2 is limited to 1630 designated ficers only. A similar course of study (without heavy intelligence nphasis and no language training available for U.S. Navy officers) is ailable for other designators within the National Security Affairs udies curriculum 684.

NTRY DATES

ientific and Technical Intelligence is a six-quarter course of study th a starting date in April. In addition, all students will report for math and physics refresher in mid-February. Soviet Studies telligence is an eight-quarter course of study with a starting date in ly. Operational Intelligence is either a four-quarter (1630 and SMC) or five-quarter (other designators) course of study with a arting date in July. If further information is needed, contact the ademic Associate or the Curricular Officer for this curriculum.

TELLIGENCE SUBSPECIALTY

mpletion of any of the three curricula qualifies an officer as an telligence Subspecialist with one of the following subspecialty des:

ack 1 - Scientific and Technical	XX17
ack 2 - Soviet Studies	XX18 (proposed)
ack 3 - OPINTEL	XX19 (proposed)

pical Jobs in this Subspecialty:
erations Intelligence Analyst: NAVOPINTCEN, Washington, DC
chnical Intelligence: COMNAVFOR JAPAN
val Attache: Attache USSR
mmander Shore Activity: NTIC, Washington, DC
aff Operations/Submarine Operations: CINCUSNAVEUR LONDON
telligence Officer: COMSUBGRU
rface Analyst: FOSIF ROTA/KAMISEYA
ctical Intelligence: Office of the Secretary of Defense
elligence Officer: War College, Newport, RI
elligence Production Analyst: NORAD/ADCOM JNT SUPP

GREE

quirements for the degree Master of Science in National Security fairs are met en route to satisfying the skill requirements of the ientific and Technical Intelligence program. Requirements for the gree Master of Arts in National Security Affairs are met en route to isfying the skill requirements of the Soviet Studies Intelligence or erational Intelligence programs.

rriculum 825
ademic Associate:
Grassey, Associate Professor,
de NS/Gt, Root Hall, Room 201F,
8) 646-3450/2521, AV 878-3450/2521.

Curricular Officer:
Walter A. Ericson,
CAPT, USN,
Code 34, Halligan Hall,
Room 220,
(408) 646-2033,
AV 878-2033.

NAVAL ENGINEERING PROGRAMS
CURRICULUM 570

The objective of this program is to provide graduate education, primarily in the field of Mechanical Engineering. The graduate will have the technical competence to operate and maintain modern warships and naval systems. He or she will be able to participate in technical aspects of naval systems acquisitions for technological advances in naval ships and systems. Through emphasis on the design aspect within the program, the graduate will be well prepared to apply these advances in technology to the warships of the future. An original research project resulting in a finished thesis is an integral part of the curriculum. The schedule of classes is arranged to provide time during the final two quarters for concentration in this area of specialization.

REQUIREMENTS FOR ENTRY

A baccalaureate degree or its equivalent is required, preferably in an engineering discipline. A minimum academic profile code (APC) of 323 (334 via Engineering Science Curriculum 460) is required. This equates to a minimum grade point average of 2.20, with mathematics through differential and integral calculus and one year of calculus-based physics as non-waiverable requirements. The program is open to naval officers in the rank of LTJG through LCDR in the 11XX/14XX community, equivalent grade officers of other U.S. services and qualified foreign military officers. DOD employees are also eligible. Current enrollment is approximately 135 students.

NAVAL ENGINEERING SUBSPECIALTY

Completion of this curriculum qualifies an officer as a Naval Engineering Specialist with a subspecialty code of XX54P. The curriculum sponsor is Naval Sea Systems Command. A limited number of particularly well qualified students may be able to further their education beyond the Master's Degree and seek the degree of Mechanical Engineer and a XX54N Subspecialty Code.

TYPICAL SUBSPECIALTY ASSIGNMENTS

Upon award of the XX54P subspecialty code, the officer becomes eligible for assignment to those billets identified as requiring graduate education in Naval Engineering. Typical of these billets are the following:

Industrial Activities - Shipyard, SUPSHIP: Ship Repair Facility
Mechanical Engineering Instructor, USNA
Tender Repair Officer (Engineering Duty Officer)
Fleet/Type Commander Staff, SIMA
Board of Inspection and Survey
Propulsion Examining Board

ENTRY DATES

Naval Engineering is a nine-quarter course of study with entry dates four times per year. If further information is needed, contact the Academic Associate or the Curricular Officer for this curriculum.

Curriculum 570
Academic Associate:
Turgut Sarpkaya, Distinguished Professor,
Code ME/Sl, Halligan Hall, Room M2,
(408) 646-3425, AV 878-3425.

DEGREE

Requirements for the degree Master of Science in Mechanical Engineering are met as a milestone en route to satisfying the educational skill requirements of the curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

MA1118	(5-2)	Multivariable Calculus
MA2089	(4-1)	Vector Analysis with Matrix Algebra
ME2101	(4-1)	Thermodynamics
ME2501	(3-0)	Statics

Quarter 2

MA2121	(4-0)	Ordinary Differential Equations
ME2440	(3-0)	The Digital Computer as an Engineering Tool
ME2441	(0-2)	Engineering Computational Laboratory
ME2502	(4-1)	Dynamics
ME2601	(3-2)	Solid Mechanics I

Quarter 3

MA3132	(4-0)	Partial Differential Equations
ME2201	(3-2)	Introduction to Fluid Dynamics
ME2301	(3-1)	Introduction to Naval Architecture
ME2801	(3-2)	Introduction to Engineering Systems

Quarter 4

MA3243	(3-2)	Numerical Methods for Partial Differential Equations
ME3150	(4-2)	Heat Transfer
ME3201	(3-2)	Intermediate Fluid Mechanics
ME3801	(3-0)	Linear Automatic Controls
ME3802	(0-2)	Controls Laboratory

Quarter 5

EC2170	(4-2)	Introduction to Electrical Engineering
ME3220	(3-2)	Auxiliary and Turbomachinery
ME3711	(4-1)	Design of Machine Elements
MS3201	(3-2)	Materials Science

Quarter 6

ME3611	(4-0)	Solid Mechanics II
ME3240	(3-0)	Reciprocating and Gas Turbine Power Plants
ME3241	(0-3)	Power Plants Laboratory
ME3521	(3-2)	Mechanical Vibrations
MS3202	(3-2)	Failure Analysis

Quarter 7

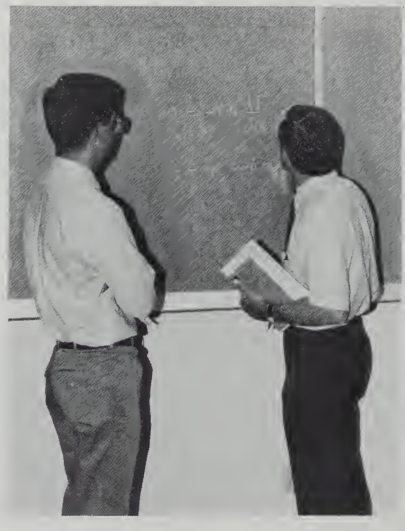
EC3370	(3-2)	Electromechanical Energy Conversion
ME3410	(2-4)	Mechanical Engineering Laboratory
ME4XXX		Elective
OS3104	(4-0)	Statistics for Science and Engineering

Quarter 8

ME0810	(0-0)	Thesis Research
ME0810	(0-0)	Thesis Research
ME4XXX		Elective
ME4XXX		Elective

Quarter 9

ME0810	(0-0)	Thesis Research
ME0810	(0-0)	Thesis Research
ME4XXX		Elective
NS3252	(4-0)	Joint and Maritime Strategic Planning



PERATIONS ANALYSIS
URRICULUM 360

his program provides education in the application of quantitative alyses to operational, tactical and managerial problems. The sciplines of mathematics, probability, statistics, economics, human ctors, physical science and optimization which the officer student arns here or brings with him, supply the theoretical background for alyzing alternative choices in tactical and strategic warfare and in anning, budgeting and procurement of systems and forces. The urse of study generates computational capability and develops skills identifying relevant information, generating decisions criteria and lecting alternatives. This education enhances performance in all ities throughout a military career including operational billets, chnical management assignments and policy making positions.

EQUIREMENTS FOR ENTRY

baccalaureate degree with above-average grades in mathematics is quired. Completion of mathematics through single variable fferential and integral calculus is considered minimal preparation. one-year course in college physics is highly desired. Students cking these quantitative prerequisites will be accepted in certain ses, where their undergraduate records indicate that they are ceptional students and there are other possible indicators of success ch as Graduate Record Examination scores, correspondence or tension courses in quantitative subjects and outstanding motivation r the program. An APC of 324 is required.

PERATIONS ANALYSIS SUBSPECIALTY

mpletion of this curriculum qualifies an officer as an Operations alysis Subspecialist with a subspecialty code of XX42P. The rriculum sponsor is OP-81, Program Resource Appraisal Division.

pical Jobs in this Subspecialty:

stroyer Squadron Chief Staff Officer
NAV Air Warfare Program Analyst
S Analyst
rector OPS Research: SACLANT
sistant Staff OPS/PLANS: COMCARGRU
aff OPS and PLAN: COMTHIRDFLT

TRY DATES

erations Analysis is an eight-quarter course of study with entry tes in April and October. If further information is needed, contact Academic Associate or the Curricular officer for this Curriculum.

rriculum 360
ademic Associate:
mes D. Esary, Professor,
de OR/Ey, Root Hall, Room 273,
8) 646-2780, AV 878-2780.

GREE

quirements for the degree Master of Science in Operations search are met as a milestone en route to satisfying the skill uirements of the curricular program.

Curricular Officer:
Roger Stemp, LCDR, USN,
Code 30, Root Hall, Room 232,
(408) 646-2786, AV 878-2786.

TYPICAL COURSE OF STUDY

Quarter 1

OA2200	(4-1)	Computational Methods for Operations
MA1118	(5-2)	Multivariable Calculus
MA2042	(4-0)	Linear Algebra
OA3101	(4-1)	Probability

Quarter 2

OA3200	(4-0)	Computational Methods for Operations Research III
MA3110	(4-0)	Topics in Intermediate Analysis
SE3301	(4-0)	Radiating Systems
OA3102	(4-1)	Probability and Statistics

Quarter 3

OA3201	(4-0)	Linear Programming
OA3401	(4-0)	Human Factors in Systems Design I
OA3301	(4-0)	Stochastic Models I
OA3103	(4-1)	Statistics

Quarter 4

OA4202	(4-0)	Network Flows and Graphs
AS3610	(4-0)	Economic Analysis and Operations Research
OA3302	(4-0)	Systems Simulation
OA3104	(3-1)	Data Analysis

Quarter 5

(First six weeks)

OA4201	(4-0)	Non-Linear Programming
AS3611	(4-1)	Planning and Capital Allocation in the Department of Defense
(Last six weeks)		Experience Tour Off Campus

Quarter 6

OA3601	(4-1)	Combat Model and Games
OA3602	(4-0)	Search Theory and Detection
OA4301	(3-2)	Stochastic Models II
OA0810	(0-0)	Thesis Research

Quarter 7

OA4603	(3-2)	Test and Evaluation
OA0810	(0-0)	Thesis Research
OA4604	(4-0)	Wargaming Analysis
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 8

OA4602	(4-0)	Campaign Analysis
OA0810	(0-0)	Thesis Research
OAXXXX		Elective
OAXXXX		Elective

PERATIONAL LOGISTICS
URRICULUM 361

his program provides education in mathematics, probability and atistics, physical science, economics, logistics and computer science. hese disciplines supply the theoretical background for analyzing ternative choices in planning for sustainability of aval Forces involved in long-range deployments.

he course of study generates computational capability d develops skills in identifying relevant information, nerating decision criteria and selecting alternatives. is education enhances performance in all duties roughout a military career including operational lets, technical management assignments and policy aking positions.

PERATIONAL LOGISTICS SUBSPECIALTY

mpletion of this curriculum qualifies an officer as an perations Logistics Subspecialist with a subspecialty of 43P. The curriculum sponsor is OP-04, Office of Chief Naval Operations (Logistics).

pical Jobs in this Subspecialty:
OS, SACLANT
G, PLANS, CINCUSNAVEUR
G, PLANS, CINCPACFLT
PNAV Fleet Mobilization
S Logistics
arfare Analyst, NSURFWPC
D Analyst
CINPAC Analyst
ad Special Studies, Strategic Systems Project Officer
-1 Analyst
ar College Professor

QUIREMENTS FOR ENTRY

baccalaureate degree with above-average grades in mathematics is quired. Completion of mathematics through single variable ferential and integral calculus is considered minimal preparation. one-year course in college physics is highly desired. Students king these quantitative prerequisites will be accepted in certain ses where their undergraduate records indicate that they are ceptional students and there are other possible indicators of success ch as Graduate Record Examination scores, correspondence or tension courses in quantitative subjects and outstanding motivation the program.

TRY DATE

erational Logistics is an eight-quarter course of study with a single ry date in October. If further information is needed, contact the ademic Associate or Curricular Officer for this curriculum.

rriculum 361
ademic Associate:
vid A. Schrady, Professor,
de OR/So, Root Hall, Room 225,
8) 646-2801, AV 878-2801.

DEGREE

Requirements for the degree Master of Science in Operations Research are met as a milestone en route to satisfying the skill requirements of the curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

OA2200	(4-1)	Computational Methods for Operations Research II
MA1118	(5-2)	Multivariable Calculus
MA2042	(4-0)	Linear Algebra
OA3101	(4-1)	Probability

Quarter 2

OA3200	(4-0)	Computational Methods for Operations Research II
MA3110	(4-0)	Topics in Intermediate Analysis
OA3610	(4-0)	Introduction to Naval Logistics
OA3102	(4-1)	Probability and Statistics

Quarter 3

OA3201	(4-0)	Linear Programming
MN4373	(4-0)	Transportation Management II
OA3301	(4-0)	Stochastic Models I
OA3103	(4-1)	Statistics

Quarter 4

OA4611	(4-0)	Logistics in Naval Warfare
AS3610	(4-0)	Economic Analysis and Operations Research
OA3104	(3-1)	Data Analysis
OA4202	(4-0)	Network Flows and Graphs

Quarter 5

(First six weeks)		
OA4201	(4-0)	Non-Linear Programming Systems Simulation
AS3611	(4-1)	Planning and Capital Allocation in the Department of Defense
(Last six weeks)		Experience Tour Off Campus

Quarter 6

OA3601	(4-1)	Combat Model and Games
OA3302	(4-0)	Systems Simulation
OA0810	(0-0)	Thesis Research
OA4612	(4-0)	Logistics Model

Quarter 7

OA4604	(4-0)	Wargaming Analysis
MN4310	(4-0)	Logistics Engineering
OA0810	(0-0)	Thesis Research
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 8

OA4602	(4-0)	Campaign Analysis
OA0810	(0-0)	Thesis Research
OA4302	(4-0)	Reliability
OAXXXX		Elective

EAPONS SYSTEMS ENGINEERING
URRICULUM 530

his program is designed to meet the needs of the military services r an officer having a strong broad-based technical education with articular applications toward weapons systems. The fundamental ask of the Weapons Systems Engineering subspecialty community is e design, development, test and evaluation, acquisition, operation d support of naval weapons systems. In support of this career attern, the objective of this curriculum is to provide advanced chnical education on a broad foundation encompassing the basic ientific, analytic and engineering principles underlying the field of aval weaponry. The specific areas of study and the levels of pertise to be attained are formulated to ensure a sound basis for chnical competence and for subsequent growth as may be required support the fundamental task of the community.

EQUIREMENTS FOR ENTRY

baccalaureate degree with mathematics through differential and tegral calculus and a calculus-based basic physics sequence are quired for direct input. Courses in the physical sciences and ngineering are highly desirable. Officers not having the required ualifications for direct input enter the program indirectly through e Engineering Science Curriculum discussed elsewhere in this talog. An APC of 323 is required.

EAPONS SYSTEMS ENGINEERING SUBSPECIALTY

mpletion of this curriculum qualifies an officer as a Weapons stems Engineering Subspecialist with a subspecialty code of XX61. e curriculum sponsor is Naval Sea Systems Command eadquarters.

ypical Jobs in this Subspecialty:
TDS-CIC: FLTCOMBDSSA, San Diego, CA
arfare Systems Officer: SPAWAR OPSUPFLD 6
eapons Instructor: Naval Academy, Annapolis, MD
aff Readiness (Weapons): COMCRUDESCGRU 1, 2, 3, 5, 8, 12
sting Officer: COMOPTEVFOR
eapons Instructor: SWOSCOLCOM

NTRY DATES

eapons Systems Engineering is a nine-quarter course of study with try dates in April and October. If further information is needed, ntact the Academic Associate or Curricular Officer for this rriculum.

urriculum 530
ademic Associate:
mes V. Sanders, Associate Professor,
de PH/Sd, Spanagel Hall, Room 146B,
08) 646-2931/2116, AV 878-2931/2116.

EGREE

quirements for the degree Master of Science in Engineering Science e met as a milestone en route to satisfying the skill requirements of e curricular program. On a case-by-case basis, some students, pending on background, may earn a Master of Science in Physics, mputer Science or one of the engineering disciplines.

Curricular Officer:
Samuel H. Brennan
CDR, USN,
Code 33, Spanagel Hall,
Room 328,
(408) 646-2116/7,
AV 878-2116/7.

TYPICAL COURSE OF STUDY

Quarter 1

PH1121	(4-2)	Basic Physics I: Mechanics
MA1118	(5-2)	Multivariable Calculus
MA2047	(4-1)	Linear Algebra and Vector Analysis
CS2970	(5-0)	Structured Programming with ADA

Quarter 2

MA2121	(4-0)	Differential Equations
EC2810	(3-2)	Digital Machines
PH2151	(4-1)	Analytical Mechanics
EC2170	(4-2)	Introduction to Electrical Engineering

Quarter 3

MA3132	(4-0)	Partial Differential Equations and Integral Transforms
PH1322	(4-1)	Physics II: Electricity and Magnetism
EC2410	(3-0)	Analog Signals
OS3104	(4-1)	Statistics

Quarter 4

PH2724	(4-0)	Physics IV: Thermodynamics
EC2420	(3-0)	Linear Systems
PH2223	(4-1)	Physics III: Optics
EC2500	(3-2)	Communication Theory

Quarter 5

PH3360	(4-1)	Electromagnetic Wave Propagation
EC2300	(3-2)	Control Systems
MS2201	(3-2)	Material Sciences
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 6

CC4200	(4-0)	Combat Systems
MS3202	(3-2)	Failure Analysis
		Specialization Course
PH2601	(4-1)	Modern Physics

Quarter 7

		Specialization Course
PH3161	(4-1)	Fluid Dynamics
CS3550	(3-2)	Combat Systems
XX0810	(0-0)	Thesis Research

Quarter 8

		Specialization Course
		Specialization Course
PH3461	(4-0)	Explosives and Explosions
XX0810	(0-0)	Thesis Research

Quarter 9

AE4712	(3-2)	Tactical Missile Systems
		Specialization Course
XX0810	(0-0)	Thesis Research
XX0810	(0-0)	Thesis Research

APONS SYSTEMS SCIENCE RRICULUM 531

hs program is designed to meet the needs of the military services
officers who have a strong broad-based technical education with
duate emphasis in engineering physics and its applications.

ddition to introductory and core courses, all students in this
iculum take courses in electromagnetic phenomena, statistical
sics, quantum physics, solid state physics and combat simulation.
epth option sequences of two or more courses are offered wherein
lents specialize in a particular area of physics. Students also
age in thesis research in an area related to these advanced
lies.

QUIREMENTS FOR ENTRY

accalaureate degree with mathematics through differential and
gral calculus and a calculus-based basic physics sequence are
uired for direct input. Courses in the physical sciences and
ineering are highly desirable. Officers who do not have the
uired qualifications for direct input enter the program indirectly
ugh the Engineering Science curriculum.

cers may enhance their selectability by taking off-campus courses.
APC of 323 is required.

APONS SYSTEMS SCIENCE SUBSPECIALTY

pletion of this curriculum qualifies an officer as a Weapons
tems Science Specialist with a subspecialty code of XX63. The
iculum sponsor is Naval Sea Systems Command Headquarters.

ical Jobs in this Subspecialty:

upons Department Head: Naval Academy, Annapolis, MD
earch Associate: Lawrence Livermore Laboratory (6)
sics Instructor: Naval Academy, Annapolis, MD
earch Associate: Los Alamos National Laboratory
tro-Optics Project Officer: Naval Ocean Systems Center,
an Diego, CA
ting Officer: COMOPTEVFOR
earch Officer: Naval Research Laboratory
ject Management: Naval Sea Systems Command (4)

TRY DATES

pons Systems Science is a nine-quarter course of study with entry
s in April and October. If further information is needed, contact
Academic Associate or Curricular Officer for this curriculum.

riculum 531
demic Associate:
es V. Sanders, Associate Professor,
e PH/Sd, Spanagel Hall, Room 146B,
) 646-2931/2116, AV 878-2931/2116.

GREE

uirements for the degree Master of Science in Physics are met as a
estone en route to satisfying the skill requirements of the
icular program.

TYPICAL COURSE OF STUDY

Quarter 1

MA2121	(4-0)	Differential Equations
PH2911	(3-2)	Computational Physics
MA2089	(4-1)	Vector Analysis

Quarter 2

PH2151	(4-1)	Particle Mechanics
PH2223	(4-0)	Optics
PH2012	(3-2)	Physics Lab I

Quarter 3

PH3152	(4-1)	Extended Systems
PH3990	(4-0)	Theoretical Physics
PH2351	(4-1)	Electromagnetism
PH2613	(2-2)	Physics Lab II

Quarter 4

PH2681	(4-0)	Introductory Quantum Physics
PH3352	(4-0)	Electromagnetic Waves
PH2014	(2-2)	Physics Lab III

Quarter 5

PH3782	(4-0)	Statistical Physics
PH3683	(4-0)	Intermediate Quantum Physics
PH4353	(4-0)	Topics in Advanced Electricity and Magnetisn

Quarter 6

		Specialization Course
PH4984	(4-0)	Advanced Quantum Physi
PH3479	(4-0)	Underwater Weapons

Quarter 7

		Specialization Course
PH0810	(0-0)	Thesis Research
MS3201	(3-2)	Material Sciences

Quarter 8

		Specialization Course
PH0810	(0-0)	Thesis Research
PH4911	(3-2)	Weapons Systems Simulation
MS3202	(3-2)	Failure Analysis

Quarter 9

PH0810	(0-0)	Thesis Research
PH0810	(0-0)	Thesis Research
NS3252	(4-0)	Joint and Maritime Strategic Planning

UCLEAR AND DIRECTED-ENERGY WEAPONS AND EFFECTS URRICULUM 532

is program is designed to meet the needs of the naval service for icers who have a broad technical education with a graduate ecialization in the physics of nuclear weapons and weapons effects. e graduate specialization sequence consists of a series of courses in e area of nuclear physics, effects of nuclear explosions, hardening hnologies and nuclear warfare analysis. Students can also take ective courses in this or related areas and are expected to engage in esis research in their field of specialization.

EQUIREMENTS FOR ENTRY

baccalaureate degree with mathematics through differential and tegral calculus and a calculus-based basic physics sequence are quired for direct input. Courses in the physical sciences and gineering are highly desirable. Officers not having the required alifications for direct input enter the program indirectly through e Engineering Science Curriculum discussed elsewhere in this talog.

ficers may enhance their selectability by taking off-campus courses. APC of 323 is required.

UCLEAR PHYSICS SUBSPECIALTY

mpletion of this curriculum qualifies an officer as a Nuclear and rected-Energy Weapons and Effects Subspecialist with a bspecialty code of XX67. The curriculum sponsor is OP-981N, adquarters, Nuclear Branch.

pical Jobs in this Subspecialty:

st Manager: Defense Nuclear Agency (DNA)
search and Development Coordinator: Defense Nuclear Agency (DNA)
ysicist: Defense Nuclear Agency (DNA)
ctical Nuclear Weapons/Plans: CINCLANT (2)
st Officer/Programs Officer: DNA, Dirkland AFB (2)
vy Research Officer: Los Alamos National Laboratory (3)
vy Research Officer: Lawrence Livermore Laboratory
clear Effects Officer/Nucleonics Officer: SPAWARSYSCOM (2)
clear Physicist: DNA, Los Alamos
structor: Nuclear Weapons Training Group - Atlantic

NTRY DATES

is is a nine-quarter course of study with entry dates in April and tober. If further information is needed, contact the Academic sociate or Curricular Officer for this curriculum.

rriuclum 532
ademic Associate:
mes V. Sanders, Associate Professor,
de PH/Sd, Spanagel Hall, Room 146B,
08) 646-2931/2116, AV 878-2931/2116.

EGREE

quirements for the degree Master of Science in Physics are met as a lestone en route to satisfying the skill requirements of the rricular program.

TYPICAL COURSE OF STUDY

Quarter 1

PH1121	(4-2)	Basic Mechanics
MA1118	(5-2)	Multivariable Calculus
PH2911	(3-2)	Computational Physics
MA2089	(4-1)	Vector Analysis

Quarter 2

PH1322	(4-1)	Physics II: Electricity and Magnetism
MA2121	(4-0)	Differential Equations
PH2012	(2-2)	Physics Lab I
PH2151	(4-1)	Analytical Mechanics

Quarter 3

PH2013	(2-2)	Physics Lab II
PH3990	(4-0)	Theoretical Physics
PH2351	(4-1)	Electromagnetism
PH3152	(4-1)	Extended Systems

Quarter 4

PH2014	(2-2)	Physics Lab III
PH2681	(4-0)	Introductory Quantum Physics
PH3352	(4-0)	Electromagnetic Waves
PH2223	(4-0)	Physics III: Optics

Quarter 5

PH3782	(4-0)	Statistical Physics
PH3683	(4-0)	Intermediate Quantum Physics
PH4353	(4-0)	Topics in Advanced Electricity and Magnetism
PH3855	(4-2)	Nuclear Physics

Quarter 6

SE4858	(4-0)	Nuclear Warfare
PH4856	(4-0)	Nuclear Explosions
		Experience Tour Off Campus

Quarter 7

PH4750	(4-0)	Radiation Effects
PH4857	(4-0)	Transport Theory
PH3161	(4-1)	Fluid Dynamics
PH0810	(0-0)	Thesis Research

Quarter 8

PH4911	(3-2)	Weapons Systems Simulation
PH3461	(4-0)	Explosions and Explosives
PH4984	(4-0)	Advanced Quantum Physics
PH0810	(0-0)	Thesis Research

Quarter 9

MS3201	(3-2)	Material Sciences
PH0810	(0-0)	Thesis Research
PH0810	(0-0)	Thesis Research
NS3252	(4-0)	Joint and Maritime Strategic Planning

NDERWATER ACOUSTIC SYSTEMS
URRICULUM 535

nderwater Acoustic Systems is an interdisciplinary program.
urses are drawn principally from the fields of physics, electrical
gineering, computer science and mathematics. Although broadly
sed, the emphasis is on underwater acoustics and signal processing
plications to undersea warfare. As can be seen in the following list,
urses included relate to the generation and propagation of sound in
e ocean, military applications of underwater sound and the
ctrical engineering and computer science aspects of signal
ocessing in sonar systems. Also included are topics concerning the
ects of the noise environment on people.

EQUIREMENTS FOR ENTRY

baccalaureate degree with mathematics through differential and
egral calculus and a calculus-based basic physics sequence are
quired for direct input. Courses in the physical sciences and
gineering are highly desirable. Officers not having the required
alifications for direct input enter the program indirectly through
e Engineering Science Curriculum discussed elsewhere in this
talog.

ficers may enhance their selectability by taking off-campus courses.
APC of 323 is required.

NDERWATER ACOUSTICS SUBSPECIALTY

mpletion of this curriculum qualifies an officer as an Under-
ter Acoustics Subspecialist with a subspecialty code of XX56.
e curriculum sponsor is Naval Sea Systems Command/Com-
nder Space and Naval Warfare Systems Command.

pical Jobs in this Subspecialty:
ysics Instructor: Naval Academy, Annapolis, MD
-981N: OPNAV
structor: Naval Postgraduate School, Monterey, CA
aining Officer: PDW-124 (Undersea Surveillance)
aff: Commander 7th Fleet
aff: COMNAVSURFLANT
st and Evaluation Officer: OPTEVFOR
rategic Systems Project Officer: Director of SSPO
aff Antisubmarine Warfare: NAVSEASYSCOM
search and Development Project Officer: Office of Secretary
of Defense

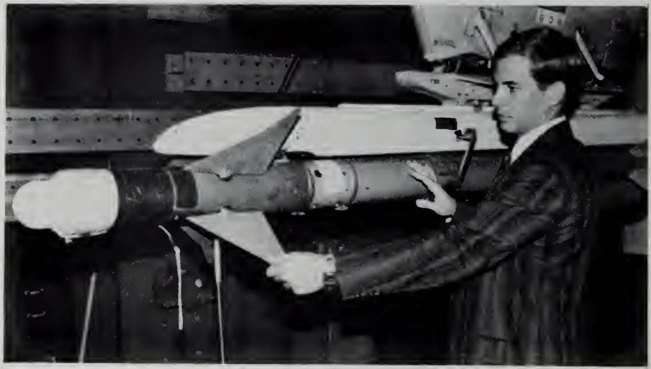
NTRY DATES

nderwater Acoustics is a nine-quarter course of study with entry
tes in April and October. If further information is needed, contact
e Academic Associate or Curricular Officer for this curriculum.

rriculum 535
ademic Associate:
mes V. Sanders, Associate Professor,
de PH/Sd, Spanagel Hall, Room 146B,
08) 646-2931/2116, AV 878-2931/2116.

EGREE

quirements for the degree Master of Science in Engineering
oustics are met as a milestone en route to satisfying the skill
quirements of the curricular program.



TYPICAL COURSE OF STUDY

Quarter 1

PH2911	(2-2)	Structured Programming
MA1118	(5-2)	Multivariable Calculus
EC2170	(4-2)	Electrical Engineering
MA2089	(4-1)	Vector Analysis

Quarter 2

PH2119	(4-2)	Oscillations and Waves
MA2121	(4-0)	Differential Equations
PH2724	(4-0)	Thermodynamics
PH2012	(3-2)	Physics Lab I

Quarter 3

PH3451	(4-2)	Fundamental Acoustics
PH3990	(4-0)	Theoretical Physics
EC2410	(3-0)	Fourier Analysis
EC2400	(3-6)	Discrete Systems

Quarter 4

PH3452	(4-2)	Underwater Acoustics
OS2102	(4-1)	Probability for Electrical Engineering
EC3400	(3-1)	Digital Signal Processing
NS3252	(4-0)	Joint and Maritime Strategic Planning

Quarter 5

PH4453	(4-0)	Propagation in the Ocean
PH3360	(4-1)	Electromagnetic Wave Propagation
EC3410	(4-0)	Discrete-Time Random Processes
PH3458	(4-0)	Noise, Shock and Vibrations

Quarter 6

PH4410	(1-6)	Acoustics Laboratory
PH4455	(4-0)	Scattering and Fluctuations
EC4470	(3-1)	Adaptive Signal Processing
PH2410	(3-2)	Analog Electronics and Signal Conditioning for Acoustics

Quarter 7

PH4454	(4-2)	Transducer Theory and Design
PH3410	(3-2)	Fiber-Optic Systems
OC3261	(4-0)	Ocean Factors in Acoustics
PH0810	(0-0)	Thesis Research

Quarter 8

EC4440	(3-1)	Multidimensional Signal Processing
EC4570	(4-0)	Decision and Estimation
PH0810	(0-0)	Thesis Research
EC4450	(4-1)	Sonar System Engineering

Quarter 9

PH3161	(4-1)	Fluid Dynamics
PH4456	(3-0)	Seminar in Applications
PH0810	(0-0)	Thesis Research
PH0810	(0-0)	Thesis Research

ADVANCED SCIENCE (APPLIED MATHEMATICS) CURRICULUM 380

This program is designed to meet the needs of the Department of Defense for graduates who are skilled in the concepts of higher mathematics. The objective of the program is to equip an officer with the skill to: analyze a military problem; formulate it in mathematical terms; solve or approximate a solution; interpret and present the results.

Completion of this curriculum also qualifies an officer as an Applied Mathematics Subspecialist with a subspecialty code of XX41. The curriculum sponsor is the U.S. Naval Academy Department of Mathematics. The typical job in this subspecialty is an instructor in mathematics at the U.S. Naval Academy or the U.S. Military Academy at West Point.

REQUIREMENTS FOR ENTRY

Preparatory to graduate work in applied mathematics, the officer shall have completed a strong program of study at the undergraduate level or the first three quarters of the mathematics core sequence, which includes linear algebra, advanced calculus in one and several variables, ordinary differential equations, probability and statistics. Officers not having the required qualifications for direct input enter the program indirectly through the Engineering Science curriculum discussed elsewhere in this catalog. An APC of 323 is required.

ENTRY DATES

Advanced Science (Applied Mathematics) is an eight-quarter course of study with entry dates in any quarter. If further information is needed, contact the Academic Associate or Curricular Officer for this curriculum.

Curriculum 380
Academic Associate:
Maurice D. Weir, Professor,
Code MA, Ingersoll Hall, Room 335,
(408) 646-2608, AV 878-2608.

DEGREE

Requirements for the degree Master of Science in Mathematics are met as a milestone en route to satisfying the skill requirements of th curricular program.

TYPICAL COURSE OF STUDY

Quarter 1

MA1118	(5-2)	Multivariable Calculus
MA2089	(4-1)	Vector Analysis and Matrix Algebra
MA2042	(4-0)	Linear Algebra
MA0125	(3-0)	Introduction to Finite Mathematics

Quarter 2

MA2121	(4-0)	Ordinary Differential Equations
MA2025	(4-1)	Bridge to Advanced Mathematics
OA3101	(4-1)	Probability
OA2200	(3-2)	Computational Methods (FORTRAN or APL Programming)

Quarter 3

MA3110	(4-0)	Intermediate Analysis
MA3132	(4-0)	Partial Differential Equations
MA3232	(4-1)	Numerical Analysis
OA3102	(4-1)	Probability and Statistics

Quarter 4

MA3605	(3-0)	Fundamentals of Analysis I
MA4237	(4-0)	Advanced Numerical Analysis
MA3560	(3-0)	Modern Applied Algebra
OA3103	(4-1)	Statistics

Quarter 5

MA3606	(3-0)	Fundamentals of Analysis II
MA3243	(4-1)	Numerical Partial Differential Equations
MA3046	(4-1)	Advanced Linear Algebra
MA3730	(3-0)	Numerical Computation

Quarter 6

MA3400	(4-0)	Mathematical Modeling Processes
MA4611	(3-0)	Calculus of Variations
MA4391	(3-0)	Numerical Fluid Dynamics I
OA3201	(4-0)	Linear Programming

Quarter 7

MA3035	(2-1)	Microprocessors
NS3252	(4-0)	Joint and Maritime Strategic Planning
MA4392	(3-0)	Numerical Fluid Dynamics II
MA0810	(0-0)	Thesis Research

Quarter 8

		Elective
MA4300	(3-0)	Thesis Topics Seminar
MA0810	(0-0)	Thesis Research
MA0810	(0-0)	Thesis Research

TYPICAL COURSE OF STUDY (Applied Math Option)

Quarter 1

MA1118	(5-2)	Multivariable Calculus
MA2089	(4-1)	Vector Analysis and Matrix Algebra
MA2042	(4-0)	Linear Algebra
MA0125	(3-0)	Introduction to Finite Mathematics

Quarter 2

MA2121	(4-0)	Ordinary Differential Equations
MA2025	(4-1)	Bridge to Advanced Mathematics
OA3101	(4-1)	Probability
OA2200	(3-2)	Computational Methods (FORTRAN or APL Programming)

Quarter 3

MA3110	(4-0)	Intermediate Analysis
MA3132	(4-0)	Partial Differential Equations
MA3232	(4-1)	Numerical Analysis
OA3102	(4-1)	Probability and Statistics

Quarter 4

MA3605	(3-0)	Fundamentals of Analysis I
MA3400	(4-0)	Mathematical Modeling Processes
MA3560	(3-0)	Modern Applied Algebra
OA3103	(4-1)	Statistics

Quarter 5

MA3606	(3-0)	Fundamentals of Analysis II
MA3675	(3-0)	Complex Analysis I
MA3046	(4-1)	Advanced Linear Algebra
		Outside Elective I

Quarter 6

MA4622	(3-0)	Principles of Applied Mathematics I
MA3676	(3-0)	Complex Analysis II
MA4611	(3-0)	Calculus of Variations
		Outside Elective II

Quarter 7

MA4623	(3-0)	Principles of Applied Mathematics II
NS3252	(4-0)	Joint and Maritime Strategic Planning
		Outside Elective III
MA0810	(0-0)	Thesis Research

Quarter 8

MA4672	(3-0)	Integral Transforms
MA4300	(3-0)	Thesis Topics Seminar
MA0810	(0-0)	Thesis Research
MA0810	(0-0)	Thesis Research

CURRICULA CONDUCTED AT OTHER UNIVERSITIE

The Navy's fully funded graduate education program supports 71 subspecialties. This involves curricula, 42 at NPS and 36 at over 62 civilian institutions. Programs available at NPS are not offered at civilian institutions. Approximately 20% of the fiscal year officer graduate education assignments are slated for these universities. Where more than one school is listed for a particu curriculum, subspecialty education placement officers plan quota distribution.

In order to qualify for the Civilian Institutions program, officers must be Postgraduate School selected and must meet all the requirements of the civilian institution.

Curriculum	Number	Length	Institution	Primary Consulta
Chemistry	382	2 yrs.	Various	NAVSEASYSC
Criminal Law	884	1 yr.	Various	NJA
Education and Training Management	867	12-18 mos.	Various	CN
Environmental Law	880	1 yr.	Various	NJA
Facilities Engineering	47X	1-2 yrs.	Various	NAVFACENGCO
Health Care Law	885	1 yr.	Various	NJA
International Law	887	1 yr.	Various	NJA
Joint Intelligence	990	9-12 mos.	Defense Intell. Sch.*	NAVINTCO
Labor Law	886	1 yr.	Various	NJA
Advanced Military Justice	881	9-12 mos.	JAG School	NJA
Logistics Management	770	15 mos.	Air Force Institute of Technology*	NAVAIRSYSCO
National Security (International Relations and Diplomacy)	680	12 mos.	Harvard (JFK School of Government) Tufts (Fletcher)	CNO OP-0
National Security (International Relations and Diplomacy)	690	12 mos.	Various	CNO OP-0
Naval Construction and Engineering	510	2-3 yrs.	M.I.T.	NAVSEASYSCO
Nuclear Engineering (ED)	520	2 yrs.	M.I.T.	NAVSEASYSCO
Nuclear and Directed-Energy Weapons and Effects	521	18 mos.	Air Force Institute of Technology*	CNO OP98I
Ocean Engineering	472	15-18 mos.	Various	NAVFACENGCO
Ocean Law	883	1 yr.	Various	NJA
Operational Oceanography	375	27 mos.	M.I.T.	CNO OP-09
Petroleum Management	811	18-21 mos.	University of Kansas	NAVSUPSYSCO
Petroleum Engineering	630	12-24 mos.	Various	NAVFACENGCO
Public Affairs	920	1 yr.	Various	CHINF
Religion	97X	9 mos.	Various	CHCHA
Retailing	830	18-21 mos.	Various	NAVSUPSYSCO
Subsistence Technology	860	18-21 mos.	Michigan State	NAVSUPSYSCOM
Supply Acquisition/ Distribution Management	810	18-21 mos.	NAVSUPSYSCOM	
Tax Law	882	1 yr.	Various	NJAG

*No NROTC Unit at Institution

Inquiries concerning curricula conducted at other universities should be directed to:

Manager, Civilian Institutions Program,
Naval Postgraduate School, Monterey, CA 93943.
Telephone (408) 646-2319 or Autovon 878-2319.

Detailed information and the list of approved civilian institutions for the above curricula may be found in OPNAVNOTE 1520.

DEPARTMENT OF ADMINISTRATIVE SCIENCES

Tarek Abdel-Hamid, Assistant Professor of Management Information Systems (1986)*; PhD, MIT Sloan School of Management, 1984.

Frank J. Barrett, Assistant Professor of Organization and Management (1990); PhD, Case Western Reserve University, 1989; MA, University of Notre Dame, 1977; BA, University of Notre Dame, 1975.

Hemant K. Bhargava, Assistant Professor of Management Information Systems (1989); PhD, The Wharton School, University of Pennsylvania, 1990.

Dan Calvin Boger, Associate Professor of Economics (1979); PhD, University of California at Berkeley, 1979.

Tung Xuan Bui, Associate Professor of Management Information Systems (1984); PhD, New York University, 1985.

Paul Marshman Carrick, Associate Professor of Economics (1969); PhD, University of California at Berkeley, 1956.

William Howard Church, Professor Emeritus (1956); MSPA, University of Southern California, 1941.

Alice Crawford, Adjunct Professor of Psychology (1988); MA, San Diego State University, 1973.

John Wallis Creighton, Professor Emeritus (1967); PhD, University of Michigan, 1954.

Leslie Darbyshire, Professor Emeritus (1961); DBA University of Washington, 1957.

Daniel Roy Dolk, Associate Professor of Management Information Systems (1982); PhD, University of Arizona, 1982.

Richard B. Doyle, Associate Professor of Public Budgeting (1990); PhD, University of Washington, 1982.

Cynthia Helen Dresser, Adjunct Professor of English as a Second Language (ESL) (1989); MS, Monterey Institute of International Studies, 1987.

Glenn D. Eberling, Commander, U.S. Navy, Instructor in Financial Management (1988); MS, Naval Postgraduate School, 1982.

Richard S. Elster, Dean of Instruction, Professor of Administrative Sciences (1969); PhD, University of Minnesota, 1967.

Mark Jan Eitelberg, Associate Professor of Public Administration (1982); PhD, New York University, 1979.

Kenneth J. Euske, Associate Professor of Accounting (1978); PhD, Arizona State University, 1978.

Roger Dennis Evered, Professor of Management (1979); PhD, University of California at Los Angeles, 1973.

Chairman:
David R. Whipple, Jr.,
Professor,
Code AS, Ingersoll Hall,
Room 229,
(408) 646-2161, AV 878-2161.

Associate Chairmen:

Instruction
Daniel R. Dolk,
Associate Professor,
Code AS/Dk, Ingersoll Hall,
Room 316,
(408) 646-2260, AV 878-2260.

Research
Stephen L. Mehay, Professor,
Code AS/Mp, Ingersoll Hall,
Room 246,
(408) 646-2643, AV 878-2643.

Systems Development
Shu S. Liao, Professor,
Code AS/Lc, Ingersoll Hall,
Room 302,
(408) 646-2505, AV 878-2505.

Gail L. Fann, Associate Professor of Management Communication (1989); EDD, Arizona State University, 1986.

James Morgan Fremgen, Professor of Accounting (1965); DBA, Indiana University, 1961.

Barry Albert Frew, Adjunct Professor of Information Systems (1984); MS, Naval Postgraduate School, 1984.

William R. Gates, Adjunct Professor of Economics (1988); PhD, Ya University, 1984.

Linda Gorman, Adjunct Professor of Economics (1988); University Pittsburgh, 1982.

William James Haga, Adjunct Professor of Management Informati Systems (1988); PhD, University of Illinois, 1972.

David Richard Henderson, Associate Professor of Economics (1984); PhD, University of California at Los Angeles, 1976.

Susan P. Hocevar, Adjunct Professor of Organization and Management (1990); PhD, University of Southern California, 1990; MA, Cornell University (1975); BA, University of Rochester (1970).

Fenn Clark Horton, Associate Professor of Economics (1964); PhD, Claremont Graduate School, 1968.

Carl Russell Jones, Professor of Information and Telecommunications Systems (1965); PhD, Claremont Graduate School, 1965.

Lawrence R. Jones, Professor of Financial Management and Budgeting (1987); PhD, University of California at Berkeley, 1977.

Magdi Nessim Kamel, Assistant Professor of Management Information Systems (1988); PhD, University of Pennsylvania, The Wharton School, 1988.

Keebom Kang, Adjunct Professor of Logistics (1988); PhD, Industria Engineering, Purdue University, 1984.

Melvin Bernard Kline, Professor Emeritus (1970); PhD, University of California at Los Angeles, 1966.

Robert Lewis Knight, Lieutenant Commander, U.S. Navy, Instructor in Management Information Systems (1988); MS, Naval Postgraduate School, 1985.

Shanthi J. Kumarasamy, Adjunct Instructor of Information System (1989); MS, Texas Tech University, 1989.

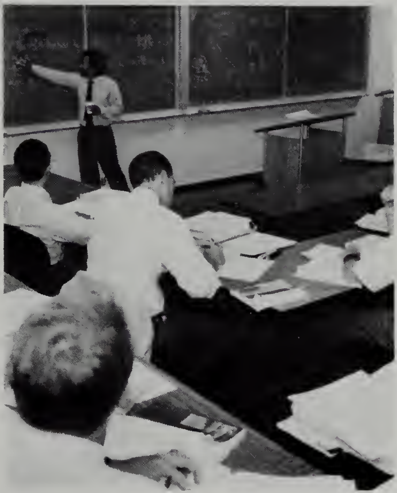
David Vincent Lamm, Associate Professor of Acquisition and Contract Management (1978); DBA, George Washington University, 1976.

Shu Sheng Liao, Professor of Accounting (1977); PhD, University of Illinois, 1971.

anny Gerald Matthews, Commander, U.S. Navy, Assistant rofessor of Accounting (1986); MS, Naval Postgraduate School, 1983.

erry Lee McCaffery, Professor of Public Budgeting (1984); PhD, niversity of Wisconsin, 1972.

artin J. McCaffrey, Adjunct Professor of Contracting and cquisition and Management Information Systems (1988); MS, Naval stgraduate School, 1985.



lan Wayne McMasters, Professor of Operations esearch and Administrative Sciences (1965); PhD, niversity of California at Berkeley, 1966.

ephen Louis Mehay, Professor of Labor Economics 985); PhD, University of California at Los Angeles, 73.

homas Preston Moore, Assistant Professor of anagement Science (1986); PhD, Virginia lytechnic Institute and State University, 1985.

rrin Douglas Moses, Associate Professor of ccounting (1985); PhD, University of California at s Angeles, 1983.

alasubramaniam Ramesh, Assistant Professor of formation Systems (1990); PhD, New York niversity, 1990.

enjamin J. Roberts, Associate Professor of anagement and Human Resource Development 985); PhD, Pennsylvania State University, 1977.

ancy Charlotte Roberts, Associate Professor of Strategic anagement (1986); PhD, Stanford University, 1983.

seph Girard San Miguel, Professor of Accounting (1982); PhD, niversity of Texas, 1972.

rman Floyd Schneidewind, Professor of Information Sciences 971); DBA, University of Southern California, 1966.

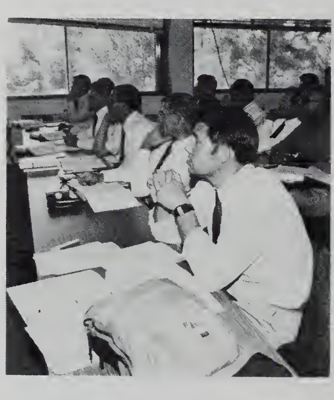
hn David Senger, Professor Emeritus (1957); PhD, University of inois, 1965.

shore Sengupta, Assistant Professor of Management Information stems (1989); PhD, Case Western Reserve University, 1990.

erling D. Sessions, Adjunct Professor (1989); PhD, Harvard niversity, 1962.

ymond William Smith, Lieutenant Commander, U.S. Navy, sistant Professor in Acquisition and Contract Management (1985); S, Naval Postgraduate School, 1982.

ren Michael Solnick, Associate Professor of Labor Economics 985); PhD, Cornell University, 1973.



Kenneth W. Steiner, Lieutenant Commander, U.S. Navy; Military Faculty (1989); MS, Naval Postgraduate School, 1986.

James Edward Suchan, Associate Professor of Management Communications (1986); PhD, University of Illinois, 1980.

Myung Suh, Assistant Professor of Management Information Systems (1989); PhD, University of Rochester, 1989.

Donald E. Summers, Lieutenant Colonel, U.S. Marine Corps, Instructor in Financial Management (1989); MS, Naval Postgraduate School, 1985.

Katsuaki Terasawa, Adjunct Professor of Economics and Policy Analysis (1989); PhD, University of Kansas, 1971.

George William Thomas, Associate Professor of Economic (1978); PhD, Purdue University, 1971.

Kenneth W. Thomas, Professor of Administrative Sciences (1987); PhD, Purdue University, 1971.

Dan Trietsch, Associate Professor of Operations Management and Logistics (1987); PhD, Tel Aviv University, 1983.

Allan Tulloch, Commander, U.S. Navy; Military Faculty (1989); MS Naval Postgraduate School, 1972.

Ronald Alfred Weitzman, Associate Professor of Psychology (1971 PhD, Princeton University, 1959.

David Richard Whipple, Jr., Professor of Economics and Policy Analysis (1971); PhD, University of Kansas, 1971.

Leslie John Zambo, Adjunct Professor of Financial Management (1986); PhD, University of Texas, 1981.

Moshe E. Zviran, Assistant Professor of Management Information Systems (1988); PhD, Tel Aviv University, 1988.

Dani Zweig, Assistant Professor of Information Systems (1990); Ph Carnegie Mellon University, 1989.

*The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

The Department of Administrative Sciences has primary responsibility for three academic programs and awards three graduate degrees. The largest program is a group of curricula in Administrative Sciences. These curricula include Acquisition and Contract Management, Financial Management, Manpower/Personnel Training Analysis, Material Logistics Support, Systems Inventory Management and Transportation Management. Graduates of these curricula are awarded the degree Master of Science in Management. The Administrative Sciences curricula are accredited by the National Association of Schools of Public Affairs and Administration.

ext largest is the Computer Systems Management Curriculum, hose graduates receive the Master of Science in Information stems. Finally, the Telecommunications Systems Management urriculum leads to the degree Master of Science in elecommunications Systems Management.

he Department has three micro-computer laboratories for structional and research purposes.

ASTER OF SCIENCE IN INFORMATION SYSTEMS

candidate for the degree of Master of Science in Information stems must successfully complete or validate core courses in each of e following disciplines:

counting and Financial Management
ganization Sciences
formation Systems
mputer Science
onomics
nagement Theory and Practice
antitative Methods

addition, each candidate's curriculum must include the successful npletion of 48-quarter hours of graduate-level course work and an ceptable thesis or project. At least 12-quarter hours of the course rk must be at the 4000 level. Further, this graduate-level course rk must include at least 24-quarter hours in Administrative iences and at least 16-quarter hours in Computer Science.

e candidate's program must be approved by the Chairman of the partment of Administrative Sciences.

ASTER OF SCIENCE IN MANAGEMENT

e degree Master of Science in Management quires:

1. Completion or validation of the Management Fundamentals program, which consists of a total of 32-quarter hours of 2000 and 3000 level courses, including a minimum of the following hours by disciplines:

Accounting and Financial Management	6
Economics	6
Organization and Management	6
Quantitative Methods	8

2. In addition to the above, completion of a minimum of 48 hours of graduate-level courses, at least 12 hours of which are at the 4000 level.

3. The completion of an approved sequence of courses in the student's area of concentration.

4. The submission of an acceptable thesis on a topic previously approved by the Department of Administrative Sciences.

5. Final approval of a program from the Chairman, Department of Administrative Sciences.

MASTER OF SCIENCE IN TELECOMMUNICATIONS SYSTEM MANAGEMENT

The degree Master of Science in Telecommunications Systems Management will be awarded at the completion of an interdisciplin program that satisfies the following requirements:

1) A minimum of 56-quarter hours of graduate-level work, of whi at least 12-quarter hours must represent courses at the 4000 level.

2) The program must consist of a minimum of graduate-level cred as follows:

Administrative Sciences and Quantitative Methods	40
Communication Systems and Computer Science	16

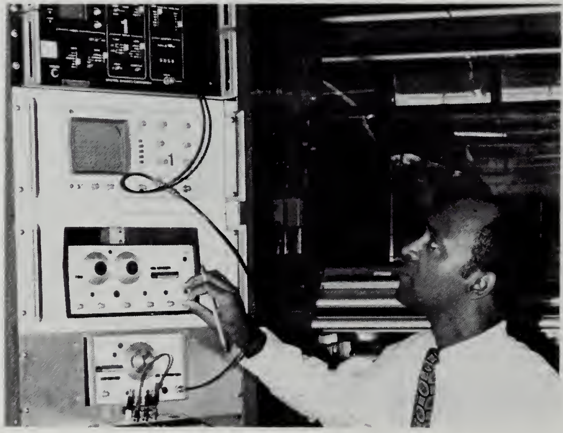
3) In addition to the 56-quarter hours of graduate-level course credit, an acceptable thesis must be completed. Each thesis sh have an advisor and a second reader, at least one of whom mus be from the Department of Administrative Sciences.

4) The program must be approved by the Chairman, Department Administrative Sciences.

COURSE OFFERINGS

AS1601 TEAM BUILDING SEMINAR: CONTEMPORARY INTERNATIONAL RELATIONS (For Allied Officers in 817 Curriculum) (4-0).

Introduction to the basic ideas of group, team, interactive process a organization. Provides experiential opportunities for students to interact and work as a team around a variety of class projects. Designed to provide opportunities for International students to become constructively integrated into the American educational system, particularly the NPS system. PREREQUISITE: Allied office enrolled in 817 curriculum.



AS1701 COMMUNICATIONS SKILLS FOR INTERNATIONALS: (For Allied Officers in 817 Curriculum) (4-0).

Designed to increase the student's ability and comprehension in communicating effectively in English through guided practice and individual tutoring in speaking, listening, reading, writing and oral presentation. Primary emphasis is o improving listening and speaking skills, especially those that will help the student through the degree program. PREREQUISITE: Allied officer enrolled in 817 curriculum, or permission of the instructor.

.901 INTRODUCTION TO AMERICAN BUSINESS ACTICES (For Allied Officers in 817 Curriculum) (4-0).

oduction to the basic language, logic concepts and practices of erican business. Presents the key functions of accounting, finance, luction, marketing, personnel management and decision making n integrated system. Draws on current events and issues in erican corporate life and local businesses. PREREQUISITE: Allied er enrolled in 817 curriculum, or permission of the instructor.

701 COMMUNICATIONS SKILLS FOR INTERNATIONALS: For Allied Officers in 817 Curriculum) (4-0).

anced version of AS1701, with focus on writing skills. Designed to ease the student's ability to communicate effectively in written lish through guided practice and individual exercises. oduction to the core concepts of communication and to the erence between effective and ineffective writing. Primary hasis is on improving the student's functional writing skills, ecially those that will help the student write reports, book maries, term papers and a thesis. PREREQUISITES: AS1701 and ollment in 817 curriculum, or permission of instructor.

610 ECONOMIC ANALYSIS AND OPERATIONS RESEARCH).

esentation of basic economic concepts involved in the decision esses of individuals and groups faced with scarcity of resources. ics covered include consumer theory and demand, individual avior under uncertainty, output and input market structures, ial and general equilibrium analysis and market imperfections welfare analysis. PREREQUISITES: MA2042, 2110(concurrently) and OA3201 (concurrently).

611 PLANNING AND CAPITAL ALLOCATION IN THE PARTMENT OF DEFENSE (4-1).

ension of concepts discussed in AS3610 to allocation of resources time. Covered are models of consumption and production over e, optimal investment decision rules and investment under ertainty. Models of welfare economics and cost-benefit analysis presented. Cost effectiveness and costing models from current tices in DOD are examined. Institutional procedures and esses such as PPBS, SYDP and weapons systems acquisition are discussed. PREREQUISITES: AS3610 and OA3103.

613 THEORY OF SYSTEMS ANALYSIS (4-0).

tems analysis (cost-effectiveness analysis) formulated as mensurable and incommensurable physical capital investment ce models. Emphasis on decision rules and the nature of ortunity costs with respect to scale and timing of investment. rpretation of methods of risk, modeling and solution computation. ory of the second best: theory of the social discount rate. oduction to models planning and control emphasizing entralization of the decision making problem. PREREQUISITES: 611 and OA4201 (concurrently).

0001 SEMINAR FOR TELECOMMUNICATION SYSTEMS NAGEMENT STUDENTS (No credit) (0-2).

st lectures. Thesis and research presentations.

CM0810 THESIS RESEARCH FOR TELECOMMUNICATIONS SYSTEMS MANAGEMENT STUDENTS (0-0).

Every student conducting thesis research will enroll in this course.

CM3001 MICROECONOMICS FOR TELECOMMUNICATIONS (4-0).

Fundamentals of resource allocations in a market-based economic system. Emphasis is on basic cost and value concepts, oligopolistic and monopolistic industry behavior and regulation of industry behavior. Examples for Telecommunications are employed. PREREQUISITES: MA1117 (or equivalent), MN2155.

CM3002 ECONOMIC EVALUATION OF TELECOMMUNICATIONS SYSTEMS (4-0).

Study of economic evaluation concepts and methods for Telecommunications Systems. Topics include cost-performance (valu analyses, capacity choice and allocating telecommunications service by pricing mechanisms. PREREQUISITES: CM3001, OS3005.

CM3112 NAVY TELECOMMUNICATIONS SYSTEMS (4-0).

Description of the Naval Telecommunications Systems, with emphas on the organization and management control and operational direction of the facilities. Current subsystems are described in detai PREREQUISITES: SECRET clearance and CM3111 or permission of the Instructor.

CM4003 SEMINAR IN TELECOMMUNICATIONS SYSTEMS MANAGEMENT (Variable hours 1-0 to 4-0) (V-0).

Study of a variety of topics of current interest in telecommunication systems, to be determined by the instructor. PREREQUISITES: A background in telecommunications systems and permission of the instructor.

CM4925 TELECOMMUNICATIONS SYSTEMS, INDUSTRY and REGULATION (4-0).

Study of the telecommunications industry (domestic and international) and its regulation by Congress, Executive Branch, Federal Communications Commission and International Telecommunications Union. Consideration of special issues, includin allocation of the spectrum, telecommunication service pricing and DOD lease decisions. PREREQUISITES: CM3002 and OS3005.

IS0001 SEMINAR FOR COMPUTER SYSTEMS MANAGEMENT STUDENTS (NO CREDIT) (0-2).

Guest lectures. Thesis and research presentations.

IS0123 COMPUTER SKILLS DEVELOPMENT (NO CREDIT) (0-2).

An introduction to the use and operation of microcomputers with emphasis on applications in the administrative sciences. Exposure to pertinent software packages. Graded on a Pass/Fail basis only.

IS0810 THESIS RESEARCH FOR COMPUTER SYSTEMS MANAGEMENT STUDENTS (0-0).

Every student conducting thesis research will enroll in this course.

For **Lieutenant Commander Robert J. Ritchie** and **Lieutenant Mary G. Ritchie**, a husband and wife team, coming to Monterey was like a breath of fresh air. After being stationed in a number of spots over the years, the Ritchie's were more than happy to make the peninsula their home.

The Ritchies are both seeking their Masters in Administrative Science; Robert's in Financial Management, Mary's in Material Management. And, with a graduation date just around the corner, the Ritchies are keeping busy with their individual research projects.

Entitled "The Effect of Extension in System Technology on Contractor Costs and Schedules" Robert's research involves using a mathematical model to help the government predict if outside contractors can meet their projected costs and schedules. Through his research and studies at NPS, Robert says, "NPS has given me a solid background in management-level financial management and controls. The experience here will help in subsequent jobs in the Supply Corps."

Mary's research involves analysis of aviation depot level repairable system gains that are recorded in the UICP retrograde managment files. Her analysis requires visits to area Naval Air Stations to study information provided by the Aviation Supply Office. Mary will be using what she learns from her studies at NPS during her next tour at the Naval Supply Center in Bremerton, Washington.

"Being in classes with students from all different aspects of the military is one of the great things about NPS," says Mary. "There's a lot of interchange going on. I'm learning as much from the people as I am from the classes."

The Ritchies, who met at the Naval Air Station in Lemoore, California, had been planning to attend NPS for several years. When asked about his stay at NPS, Robert remarked, "We were thrilled when we got recommended. We love it here...it will be hard to leave."

1004 INTRODUCTION TO PC DATABASE SYSTEMS (0-1).
is course provides an introduction to a PC-based database
nagement systems (DBMS) such as Ashton-Tate's current version
the dBase product, or PC-based Ingres. The student will develop
nple applications in the DBMS using the query processor and
sociated application generators provided by the software.
EREQUISITES: IS1001: Introduction to DOS, or a basic familiarity
th the DOS operating system for PCs.

2000 INTRODUCTION TO COMPUTER MANAGEMENT (3-1).
is course will provide an introduction to the field of automatic data
ocessing and the functions and responsibilities of the computer
nager. Specific topics include a survey of contemporary computer
plications, hardware and software, and introductions to personnel
nagement, financial management, quantitative methods and
nputer science in the computer management function.

IS3000 DISTRIBUTED COMPUTER SYSTEM (4-0).

This course covers the technology, application and management of distributed computer systems. Specific topics include distributed processing, distributed data base management, communication facilities and protocols, economic and performance analysis and managerial and organizational problems. PREREQUISITES: CS2970 CS3010 and IS3170 (may be taken concurrently.)

IS3020 SOFTWARE DESIGN (3-2).

The course is concerned with the use of structured techniques in the design and implementation of software. Topics covered include selection of programming languages, design of modules and module interfaces, testing and program documentation techniques. The cours also covers the use of software metrics for determining program size, complexity and quality.

IS3100 ANALYSIS OF MICROCOMPUTERS AND MICROPROCESSORS (4-0).

A comparative analysis of popular microcomputers-hardware and software. Analyses will be made of the following elements: microcomputer architecture (IBM AT and PS/2, Macintosh, Sun workstation); microprocessors (Intel 8026, 386 and 486 and Motorola 680000; bus systems (ISA, EISA, MCA Nubus); operating systems (DOS, OS/2, Unix); applications (document preparation, network server, workstation). Comparisons will be made both within a vendor's product line and between vendors, with respect to characteristics, strengths, limitations, applications and costs. Tours of Silicon Valley microcomputer and semi-conductor plants. Student written and oral reports on comparative analyses. Some assembly language programming will be required. PREREQUISITES: CS3010 and CS3030.

IS3170 ECONOMIC EVALUATION OF INFORMATION SYSTEMS (4-0).

The basic principles of microeconomics applied to information systems. Microeconomic topics include demand, cost, production theory, competition, monopoly, interest rates and present values. Information systems topics include capacity planning, capital budgeting, pricing for computer services and a study of the information industries (computers and software). PREREQUISITE: MN2155 (may be taken concurrently).

IS3183 MANAGEMENT INFORMATION SYSTEMS (4-0).

Study of what an information system is, how the computer and other resources fit into the system, and management considerations involved in computer-based informations systems. Issues will be discussed from the perspective of the user of information systems and not that of the MIS specialist. PREREQUISITES: MN3105 and IS0123.

IS3220 COMPUTER CENTER MANAGEMENT (3-2).

Theory and practice of the management of computer center operations. Specific topics include facilities planning, production scheduling and control, operational procedures and computer performance evaluation. PREREQUISITES: CS3030 and OS3004.

3502 COMPUTER NETWORKS: WIDE AREA/LOCAL EA (4-0).

alysis, evaluation, management and development of wide area and
al area computer networks and supporting packet switching
mputer communication systems. Specific topics include network
chitectures, protocols, functions, standards, error detection/
rrection, cost reduction, interconnection, management and security.
ample systems include Defense Data Network, System Network
chitecture, DECNET, Ethernet, token ring, broad band, fiber optics,
ivate automatic branch exchanges and satellite communications
stems. PREREQUISITES: CS2970, CS3010 and OS3004.

3503 MICRO-COMPUTER NETWORKS (3-2).

is course covers the theory, application and operation of micro-
mputer networks. Students learn, evaluate, compare and operate
veral contemporary microcomputer networks, such as IBM PC Net,
M Token-Ring, Apple Computer Apple-Talk, 3 Comm Ethernet,
inframe emulations and LAN internets. Student reports on
mparative evaluations of contemporary micro-computer networks
ll be required. The IEEE Local Area Network Standards will be
vered. PREREQUISITE: IS3502 concurrently.

4182 INFORMATION SYSTEMS MANAGEMENT (4-0).

nagement of ADP in the Federal government, especially in the
partment of Defense. Specific topics include identification of
blems managing information systems, the identification of
propriate analytical methods to reduce risk, minimize negative
pacts or to solve those problems. It is the capstone CSM course that
ws from previous courses and studies the development of practical,
rkable solutions to information resource management (IRM)
blems. PREREQUISITE: IS4200 (concurrently).

4183 APPLICATIONS OF DATABASE MANAGEMENT STEMS (4-1).

plications-oriented introduction to database management systems
hnology. Survey of current database systems and approaches to
abase technology. Technical and administrative considerations
olved in a database implementation project are considered.
dents will be expected to implement an applications systems using
atabase management package. PREREQUISITES: CS3010, CS3020
d IS2000.

4184 INFORMATION RESOURCE MANAGEMENT IN DON/ D (4-0).

is course is concerned with understanding the major aspects of IRM
d how it is conducted in DOD and DON. Special attention will be
d to database administration and information engineering.
amples of IRM and DBA practice will be presented via case studies
d by speakers with relevant expertise from the Navy, DOD and
vate sector.

185 DECISION SUPPORT SYSTEMS (4-1).

e application and design of computer-based information systems to
pport decision making for management planning, control and
rations. Survey of current decision support systems and
roaches to DSS technology, including artificial intelligence and
ert systems. Students will be expected to implement an application
tem using available DSS tools. PREREQUISITES: MN2155,
3105, OS3101 and IS2000 or equivalent.

IS4200 SYSTEM ANALYSIS AND DESIGN (4-0).
This course covers computer-based system development, including th following concepts, methodologies, tools and techniques for: information systems requirements analysis, technical and economic feasibility studies, systems costing and data communications hardware and software trade-off evaluations and specifications, conversion and testing. PREREQUISITES: CS2810, CS3010 and IS3020 or CS2810, CS3111 and CS3400.

IS4300 SOFTWARE ENGINEERING AND MANAGEMENT (4-0).
The objective of this course is to educate the student in areas of grea concern to the Department of Defense in the fields of software engineering and management. The course examines both the technological tools of software production as well as the software engineering techniques for software project management. Software testing, metrics and reliability are also covered. PREREQUISITES: CS3030, IS3170 and OS3004.

IS4320 DATABASE AND INFORMATION RESOURCE MANAGEMENT FOR C3 (4-0).
Applications-oriented introduction to database management systems technology with emphasis on C3 applications. Survey of current database systems and developments in database technology. Introduction to the concepts of information resource management an how information policy is implemented in the Navy. Specific topics include the relational data model, use of the SQL data manipulation language, aspects of database administration and the role of databas technology in information resource management. Students will be expected to implement a prototype application using a commercial relational database management system. PREREQUISITE: IS3020 Software Design, or equivalent.

IS4502 TELECOMMUNICATIONS NETWORK (4-0).
This course is primarily concerned with understanding technological trends in telecommunications networks. Topics to be covered include public packet-switched services, T1/T3 networks, satellite transmissions ISDN and OSI interoperability issues. Such technological reviews are followed by a discussion on techniques for network planning and administration. Examples of computerized network management tools are examined. Network security issues ar also discussed.

IS4800 DIRECTED STUDY IN ADVANCED INFORMATION SYSTEMS (Variable hours) (V-0).
Directed study in advanced topics in information systems of mutual interest to student and faculty member. Intended primarily to permit students to pursue in-depth subjects not fully covered in formal class work or thesis research. May be repeated for credit with a different topic. Graded on a Pass/Fail basis only.

IS4925 SEMINAR IN INFORMATION SYSTEMS (Variable hours 1-0 to 4-0) (V-0).
Study of a variety of topics of current interest in information systems, to be determined by the instructor. PREREQUISITES: A background of information systems and permission of the instructor.

MN0001 SEMINAR FOR ADMINISTRATIVE SCIENCE STUDENTS (NO CREDIT) (0-2).
Guests lectures. Thesis and research presentations.

IN0810 THESIS RESEARCH FOR ADMINISTRATIVE SCIENCE TUDENTS (0-0).
very student conducting thesis research will enroll in this course.

IN2031 ECONOMIC DECISION MAKING (4-0).
he macroeconomic section focuses on methods of national income etermination, the consumption function, the multiplier and the npact of fiscal and monetary policies. The microeconomic section nalyzes individual economic decisions and their relation to ttainment of market equilibria. PREREQUISITE: MA2300 oncurrently).

IN2111 SEMINAR IN MANPOWER, PERSONNEL and RAINING ISSUES I (0-2).
n introduction to the major issues, theory and practice of the ilitary MPT system. Graded on a Pass/Fail basis only.

IN2112 SEMINAR IN MANPOWER, PERSONNEL and RAINING ISSUES II (0-2).
xposure to elementary analysis of problems and issues in the ntemporary military MPT system. Graded on Pass/Fail basis only.

IN2113 SEMINAR IN MANPOWER, PERSONNEL AND RAINING ISSUES III (0-2).
n introduction to the training issues and technologies and their pplication in the military setting. Graded on a Pass/Fail basis only.

IN2150 FINANCIAL ACCOUNTING (4-0).
tudy of basic accounting concepts and standards. Specific topics iclude the accounting cycle, asset valuation, equities and capital ructure, earnings measurement, cash flow analysis and financial atement analysis.

IN2155 ACCOUNTING FOR MANAGEMENT (4-0).
rief introduction to financial accounting, with emphasis on the ntent and analysis of financial statements. Specific topics in anagement accounting include fundamentals of cost accounting, st-volume-profit analysis, budgeting, relevant costs for decision aking, capital budgeting and financial performance measures. losed to students in Administrative Science curricula.)

IN2302 SEMINAR FOR ACQUISITION AND CONTRACTING TUDENTS (0-2).
uests lectures. Thesis and research presentations. Preparation for ertified Professional Contracts Management certificate aminations. Graded on a Pass/Fail basis only.

IN2303 SEMINAR FOR PROGRAM MANAGEMENT TUDENTS (0-2).
his course brings both Government and industry acquisition/ rogram managers into the academic forum for interaction with udents. Guest lecturers include program executive officers, program anagers, laboratory and field personnel, OSD officials, congressional embers and staff personnel and industry representatives. Visits to overnment facilities and commercial plants. Thesis and research esentations. Graded on a Pass/Fail basis only.

MN3105 ORGANIZATION AND MANAGEMENT (4-0).
Study of the elements of management in organizations facing a dynamic environment. Emphasis is on managerial decision making, leadership, planning and control, organizational structure and planned organizational change and their systemic impacts on organizational effectiveness and adaptation.

MN3111 PERSONNEL MANAGEMENT PROCESSES (4-0).
A broad coverage of human behavior in the work situation, with special emphasis on the problem of work in the Naval environment. Topical areas covered include selection, placement, training and evaluation of personnel; motivation, remuneration, morale, supervision and working conditions in organizations; equipment design and man-machine relationships; and, consumer (user) behavio and the impact of technological programs. PREREQUISITES: MN310 and OS3106 (concurrently).

MN3123 MILITARY SOCIOLOGY (4-0).
An exploration of classical theories of sociology pertaining to civilian-military relations with modern applications to command and control problems. Sexism, racism, family dissolution, unionization, bureaucratic inertia, career patterns, professionalism and other topic are considered from the perspective of sociology. PREREQUISITE: MN3105.

MN3140 MICROECONOMIC THEORY (4-0).
Determination of the allocation of resources and the distribution of output. Consumer and producer choice theory. Partial equilibrium analysis. Welfare economics. Applications to defense problems are emphasized. PREREQUISITES: MA2300 and MN2031.

MN3161 MANAGERIAL ACCOUNTING (4-0).
Introduction to cost determination systems, including job order systems, overhead costing, variable and absorption costing and standard costs. Emphasis is on applications of financial data to planning, control and decision making. Topics covered include budgeting, flexible budgets, variance analysis, performance measures, cost-volume-profit analysis, cost analysis for decision making and capital budgeting. PREREQUISITE: MN2150.

MN3172 PUBLIC POLICY PROCESSES (4-0).
A presentation of means by which resources are allocated to the production of goods in the defense sector. The Defense Planning, Programming and Budgeting System is studied. Presidential policy making and management and Congressional budget action are considered, with emphasis on national defense concerns. PREREQUISITE: MN2031.

MN3301 SYSTEMS ACQUISITION AND PROJECT MANAGEMENT (4-0).
This course provides the student with an understanding of the underlying philosophies and concepts of the systems acquisition process and the practical application of project management methods within this process. Topics include the evolution and current state of systems acquisition management; the defense systems acquisition cycle; user-producer acquisition management disciplines and activities; and project planning, organization, staffing, directing and controlling.

MN3303 PRINCIPLES OF ACQUISITION AND CONTRACTING (4-0).
Introduction to the principles of acquisition and contracting. This course presents the fundamentals of the Federal Acquisition Regulation and the DOD Supplement; the acquisition and contracting processes, including requirements determination, acquisition strategies, basic contract law, ethics, contract types, contracting methods and acquisition/contract management techniques.

MN3304 CONTRACT PRICING AND NEGOTIATIONS (5-2).
This course involves the study of pricing theory and strategies, cost methods, cost and price analysis, cost principles, Cost Accounting Standards and contract negotiations. Students develop and sharpen negotiating skills by participating in practical negotiation exercises. PREREQUISITES: MN3140, MN3303 and OS3105.

MN3305 CONTRACT ADMINISTRATION (3-0).
This course stresses the management skills and techniques necessary for the successful administration of government prime contracts and subcontracts. Topics include managing contract progress and performance, change control, quality control, cost/financial control, property, terminations and regulatory and policy concerns. PREREQUISITE: MN3304.

MN3307 ADP ACQUISITION (4-0).
Introduction to the management principles, concepts and issues involved in Federal government acquisition of ADP requirements. The course focuses on the concepts of system acquisition and project management, as they pertain to ADP acquisition and specific purchases of computer hardware and software. PREREQUISITE: Enrollment in Computer Systems Management curriculum or permission of the instructor.

For **Lieutenant Commander Franz-Josef Lenssen** of the German Navy, coming to the Naval Postgraduate School has been an eye-opening experience. As an exchange student from Kiel, Germany, Lenssen has had the chance to view the military through the eyes of American students. "Getting to know the American students, exchanging ideas and listening to their opinions on military matters has helped change my perspective on a number of subjects. The exchange of ideas between students is a good thing."

Lenssen, who received his Masters in Management last quarter, stayed on at NPS to continue his research in manpower. "By using historical data and equations, we're trying to determine such things as what influences people to join the Navy and whether there is a surplus or shortage of officer candidates somewhere. The results could be used to place Navy recruiters."

After completing his research, Lenssen and his family will to return to Germany for his next tour as the department head in a supply school. His following tour will be related to his studies in manpower.

MN3312 CONTRACT LAW (3-0).

Examines the legal structure within which Federal Government contracts with private industry are formulated and used. Includes such topics as agency authority, contract interpretation, disputes an remedies, socio-economic laws, labor law, property, patents and data rights, conflicts of interest, protests and ethics. PREREQUISITE: MN3303.

MN3333 MANAGERIAL COMMUNICATION SKILLS (4-0).

This course provides students with the writing, speaking, listening and communication critical thinking skills required of them to be effective managers. Instruction concentrates on writing clear, concise documents, giving effective briefings and presentations, developing strong listening skills, conducting meetings that get results, managing the communication skills of subordinates and integrating new communication technologies with existing ones. PREREQUISITE Enrollment in an Administrative Sciences Curriculum or permission of the instructor.

MN3334 MANAGERIAL COMMUNICATIONS LAB FOR INTERNATIONAL STUDENTS (0-1).

This lab complements MN3333 and is specifically designed to provide practice in oral and written communications for Allied Officers. It is particularly useful in helping students identify culturally specific differences in organization and style for oral and written communications. Furthermore, students receive highly individualized instruction to help them complete managerial communications assignments.

MN3371 CONTRACTS MANAGEMENT AND ADMINISTRATION (4-0).

Study of the characteristics and phases of the contracting process. Coverage includes planning, execution and control of the contracting process; techniques used in purchasing goods and services of varying complexities; and the relationship of contracting to the acquisition process.

MN3372 MATERIAL LOGISTICS (4-0).

An overview of logistics, including forecasting, inventory management, warehousing, transportation, facilities location,materials handling and logistics planning and control processes. A variety of quantitative models and related solution procedures which support logistics decision making are introduced. PREREQUISITES: Calculus (MA2300 or equivalent), OS3101.

MN3373 TRANSPORTATION MANAGEMENT I (4-0).

Analysis of transportation systems from a managerial perspective. Topics include carriers and users of systems; alternative modes; intra and intermodal competitive relationships; regulatory and legal considerations; demand, cost and pricing analysis; and managerial resource allocation problems. Application of these topics to the U.S. domestic freight transportation network. PREREQUISITE: MN3140 (may be taken concurrently).

N3374 PRODUCTION/OPERATIONS MANAGEMENT (4-0).
nalytical techniques which facilitate production and operations
anagement. Topics include forecasting, facilities planning and
cation, manufacturing resources planning, shop floor scheduling,
ork measurement, quality control, project control, robotics and
exible manufacturing. PREREQUISITE: OS3006.

N3375 MATERIAL HANDLING SYSTEMS DESIGN (4-0).
study of the principles and systems concepts of materials handling
d their application in the design of a materials handling system. An
erview of current DOD automated materials handling systems is
so provided.

N3377 INVENTORY MANAGEMENT (4-0).
he inventory management process of the Naval Supply Systems
ommand, with emphasis on the procedures for determining when
d how much of a given item to order. Provisioning, wholesale and
tail replenishment and the supply budgetary process.
REREQUISITE: OS3006 or equivalent.

N3760 MANPOWER ECONOMICS I (4-0).
n introduction to the theoretical aspects of labor economics.
oncepts covered include the supply of labor, the demand for labor,
arket wage determination, internal labor markets, human capital
rmation and earnings functions, migration and turnover,
mpensating wage differentials and pay and employment
scrimination. PREREQUISITE: MN3140.

N3801 TECHNOLOGY TRANSFER (4-0).
he study of dissemination and utilization of technology and
sociated problems, with emphasis on communications, sociology and
ganizational factors. PREREQUISITE: MN3105 or graduate
anding in a technical curriculum and permission of the instructor.

N3900 READINGS IN ADMINISTRATIVE SCIENCE (4-0).
n individualized program of readings and study in some area of the
ministrative sciences, designed to meet the student's special
ucational needs. PREREQUISITES: A background in the area of
udy and departmental approval. Graded on a Pass/Fail basis only.

N3902 MPT COMPUTER SKILLS ENHANCEMENT (0-2).
n introduction to data analysis using a computer. Topics include
ethods of file creation, storage and transfer. Elementary
ogramming concepts are introduced using a statistical software
ckage.

N4105 MANAGEMENT POLICY (4-0).
udy and analysis of complex managerial situations requiring
mprehensive integrated decision making. Topics include operational
d strategic planning, policy formulation, executive control,
vironmental adaptation and management of change. Case studies in
th the public and private sectors are used. PREREQUISITE: Open
ly to students in the final quarter of an Administrative Science
rriculum, Computer Systems Management, or Telecommunications
ystems Management.

MN4106 MANPOWER/PERSONNEL POLICY ANALYSIS (4-0).
Study and analysis of manpower/personnel policy alternatives with emphasis on identifying the trade-offs involved, the dynamic impact of major policy decisions and the short-term and long-term consequences of decisions. Review, use and evaluation of tools to aid in selecting policy alternatives. Study of representative cases. PREREQUISITE: Open only to students in the final quarter of the Manpower, Personnel and Training Analysis curriculum.

MN4110 MULTIVARIATE MANPOWER DATA ANALYSIS I (5-1
An introduction to multivariate data analysis using regression models. Topics include data requirements, hypothesis testing, generalizations of the linear model under different covariance structures, multicolinearity, dummy variables, forecasting and estimation of binary choice models. Applications of techniques to military manpower data are stressed. PREREQUISITE: A course in statistics.

MN4111 MULTIVARIATE MANPOWER DATA ANALYSIS II (5-1
An introduction to the specialized multivariate techniques used for analysis of military manpower data. Topics include an introduction t study design and sampling theory, maximum likelihood estimation, techniques for analyzing limited dependent and qualitative data, methods for analyzing the dependence structure of a multivariate sample, analysis of duration data and an introduction to simultaneou equations models. PREREQUISITE: A course in statistics.

MN4112 PERSONNEL TESTING AND SELECTION (4-0).
Study of methods available for evaluating and predicting training an work performance in organizations like the Navy: employment interviewing, testing, life-history data and rating scales, with some reference to job analysis and recruitment. Special emphasis on testin concepts and models particularly in relation to the computerization o the Armed Services Vocational Aptitude Battery, equal employment opportunity and selection decisions based on cost benefit analysis. PREREQUISITE: MN4110 or equivalent with approval of instructor.

MN4115 TRAINING FOUNDATIONS AND MANAGEMENT (4-0).
Examination of issue in DOD training and education. Major topics include foundations of learning, training technologies and systems, design and implementation of training and program evaluation. Emphasis is placed on the application of training processes in the military environment. Course will be available as curriculum option for students in 847 (MPTA) Curriculum.

MN4117 JOB ANALYSIS AND PERSONNEL TRAINING (4-0).
Study of job analysis and it's use in determining training requirements. Consideration of instructional systems development and training pipeline management. Attention to cost-benefit issues involving training in regard to selection, equipment design, changing job requirements and career development. PREREQUISITE: MN3111.

MN4119 SEMINAR IN MANPOWER ANALYSIS
(Variable credit 1-0 to 4-0) (V-0).
Study of a variety of topics of current interest in manpower analysis, to be determined by the instructor. PREREQUISITES: A background in manpower analysis and permission of the instructor.

N4121 ORGANIZATION THEORY (4-0).
tudy of the major theories of modern organizations. This urse emphasizes the analysis of organizational phenomena om multiple perspectives, using theories of individual, oup and organizational behavior. Topics include ganization design and culture, political analysis of ganizations, management of change, open systems theory d contingency theories. PREREQUISITE: MN3105.

N4122 PLANNING AND CONTROL: MEASUREMENT ND EVALUATION (4-0).
heory and techniques of the managerial functions of anning and control. Emphasis is placed on the effects of the anning and control structure on the behavior of human mponents of the system. Topics include the problems sociated with the utilization of surrogates for measurement rposes; the analysis of the influence of assumptions, values d objectives on the planning and control process; budgeting d forecasting and performance evaluation and the reward ructure. PREREQUISITES: MN3105 and MN3161.

N4125 MANAGING PLANNED CHANGE IN COMPLEX RGANIZATIONS (4-0).
amination of the approaches to planning and managing change forts in complex social systems made up of the interdependent mponents of technology, structure, task and people and of the role the manager or staff specialist and the process of helping. nphasis is placed on strategies and technologies for diagnosis and anning aimed at effective implementation. Opportunities for actice using both simulations and actual organizational cases. cuses on problems involved in effective implementation of chnologically, structurally, or human resource based planned ange efforts. PREREQUISITE: MN3105.

N4127 SEMINAR IN ORGANIZATION BEHAVIOR ariable credit 1-0 to 4-0) (V-0).
udy of a variety of topics of current interest in organization havior, to be determined by the instructor. PREREQUISITES: A ckground in organization behavior and permission of the instructor.

N4145 POLICY ANALYSIS (4-0).
he application of economic methods to non-market transactions. alysis of large scale defense resource allocation problems. Weapon stem definition. Life cycle cost models. Examples of cost-benefit and st-effectiveness analyses. PREREQUISITES: MN3140, MN3161 and S3106.

N4151 INTERNAL CONTROL AND FINANCIAL UDITING (4-0).
udy of the objectives and techniques of internal control systems and audits of financial reports and records. Specific topics include the ernal control structure and evaluation of internal control, audit ports, audit evidence and audit tests, the auditor's decision process, atistical sampling, and special controls and audit problems in mputer-based systems. Audits of several transaction cycles are amined. PREREQUISITES: MN3161, OS3101 and a basic computer urse.

MN4152 CORPORATE FINANCIAL MANAGEMENT (4-0).
The management of the finance function in industry, with particula attention to defense contractors. Specific topics include cash and working capital management, long-term financing and determinatio of optimal capital structure. PREREQUISITE: MN3161.

MN4153 SEMINAR IN FINANCIAL MANAGEMENT (Variable hours 1-0 to 4-0) (V-0).
Study of a variety of topics of current interest in financial management, to be determined by the instructor. PREREQUISITES: A background in financial management and permission of the instructor.

MN4154 FINANCIAL MANAGEMENT IN THE ARMED FORCES (4-0).
Review of financial management concepts and practices in DOD and the Armed Forces, with emphasis on the Department of the Navy. Includes study of PPBS, controllership, budget formulation and execution, headquarters and field activity accounting systems and various types of funds. PREREQUISITES: MN2155 or MN3161 and MN3172.

MN4155 OPERATIONAL AUDITING (4-0).
This course examines auditing as a tool of management control in large, complex organizations. Case studies are used to discuss the scope of the audit, audit procedures, audit findings and recommendations, auditor training and professionalism and the role and responsibilities of auditee-managers, users of audit reports and auditors. The General Accounting Office's audit and internal control standards are also examined, as well as directives of the Office of Management and Budget, Department of Defense and Department of the Navy. During the last few weeks, students do field research on a operational audit for a local organization. PREREQUISITE: MN3161

MN4159 FINANCIAL REPORTING AND ANALYSIS (4-0).
Advanced study of basic accounting concepts underlying published financial reports. Emphasis is placed on the measurement, communication and evaluation processes. Topics include setting accounting policies, alternative bases of valuation, alternative concepts of earnings and discussion of controversial accounting issues. The course takes the perspective of managers and users of financial information. PREREQUISITE: MN3161.

N4161 MANAGEMENT CONTROL SYSTEMS (4-0).

dy of the structure and the processes of management control in ernment organizations. Specific topics include the basic concepts planning and control, organization of the management control ction, measurement of inputs and outputs, pricing government vices, programming, budgeting, accounting and performance luation. PREREQUISITES: MN3105 and MN3161.

N4162 COST ACCOUNTING (4-0).

view of basic cost accounting procedures. In-depth study of cost ounting systems, allocation of direct and indirect costs to cost ectives and special problems of accounting for materials, labor and rhead costs. Specific attention is given to the objectives and the stance of Cost Accounting Standards for negotiated defense curement contracts. PREREQUISITE: MN3161.

N4163 ANALYTICAL TECHNIQUES FOR FINANCIAL NTROL AND PLANNING (4-0).

dy of quantitative methods most useful for financial planning and trol. Emphasis is on developing quantitative methods as decision port tools, with available computer software as computational s. Covered are introductions to the relevant quantitative hniques, the conditions for successful applications, data needed for plications and the use of computational aids for problem solving. goal is to provide sufficient competency for students to apply histicated analytical techniques to various planning and control ironments in the public sector. PREREQUISITES: MN3161 and 3101.

N4301 CONTRACTING FOR MAJOR SYSTEMS (4-0).

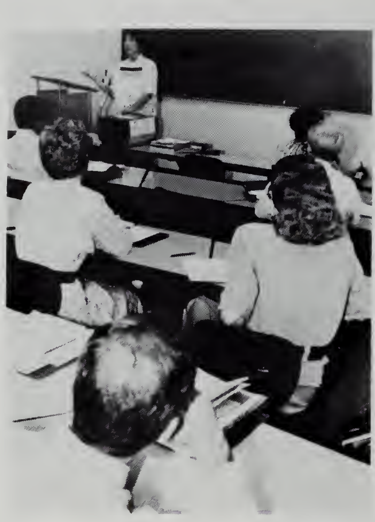
dy of the major systems contracting process, procedures and ctices. This course focuses on the contracting process of the Naval tems Commands and the Major Defense Acquisition Process. Major ics include contracting organization for systems acquisition, tems acquisition process, business clearance process, source ection, multi-year procurement pricing and administration of major tracts. Related topics include funding, reliability/maintainability, , research and development, test and evaluation, and gressional activity. PREREQUISITE: MN3305 or permission of the tructor.

4302 PUBLIC EXPENDITURE POLICY AND ALYSIS (4-0).

ional defense policy formulation and execution and its impact on defense budget. Analysis of contemporary defense policy and nagement issues and their resource implications. Relationships ween DOD, the military departments, the defense industry and gress in the policy and resource decision making process. EREQUISITE: MN3172.

4307 PROGRAM MANAGEMENT POLICY AND NTROL (4-0).

vides the student with knowledge of management control cesses and tools, design and application of control systems, use of puter-based management information systems with emphasis on world, practical systems for performance, cost and schedule trol. Case studies involving managerial problem solving and ision making in the program management environment are used. EREQUISITE: MN3301 and permission of the instructor.



MN4310 LOGISTICS ENGINEERING (4-0).
The concept of integrated logistics support and its relationships with systems engineering. Operational requirements, system maintenance concept, functional analysis, life cycle costs, logistics support analysis, systems design, test and evaluation, production, provisioning and resupply of repair and spare parts. PREREQUISITE: OS3006 (concurrently).

MN4371 ACQUISITION AND CONTRACTING POLICY (4-0).
A seminar using case studies and current acquisition issues to analyze government and business acquisition contracting policies. Emphasis is on acquisition/contracting decision making and policy formulation. PREREQUISITES: MN4301.

MN4372 SEMINAR IN ACQUISITION AND CONTRACT MANAGEMENT (Variable hours 1-0 to 4-0) (V-0).
Study of a variety of topics of current interest in acquisition and contracting, to be determined by the instructor. PREREQUISITES: A background in acquisition and permission of the instructor.

MN4373 TRANSPORTATION MANAGEMENT II (4-0).
A continuation of MN3373. Concentration on the management of large-scale transportation networks, emphasizing international transportation and the role of the U.S. merchant marine. Also cove d are the DOD transportation agencies, DOD transportation planning models and current research in commercial and military transportation. PREREQUISITES: MN3373 or permission of Instructor and SECRET NOFORN clearance.

MN4376 SEMINAR IN MATERIAL LOGISTICS (4-0).
Study of a variety of topics of current interest in logistics, to be determined by the instructor. PREREQUISITES: A background in logistics and permission of the instructor.

MN4500 PRODUCTIVITY ANALYSIS (4-0).
Study of the theoretical and institutional foundations of the analysi of productivity measurement and enhancement programs in DOD. Emphasis is placed on methods of applying microeconomic and organizational effectiveness principles and concepts to the critical analysis of proposed and existing DOD productivity programs, as w as to the development of alternatives which have higher probabiliti of effecting the desired increases in program effectiveness and efficiency. PREREQUISITES: MN3105 and MN3140.

MN4650 THE MILITARY HEALTH CARE DELIVERY SYSTEM AND ANALYSIS (4-0).
This course is designed to acquaint the student with the structure and operation of the Department of Defense's system for providing health care to those eligible under current regulations; to identity current problem areas; and, through application of systems analysis and management techniques, to address the possible solutions to these problems in a course project. PREREQUISITE: MN3650.

N4761 APPLIED MANPOWER ANALYSIS (4-0).
plication of theoretical models and quantitative techniques to litary manpower, personnel and training issues. Topics include npower supply models, attrition and reenlistment models, npower requirements determination, force structure analysis, npower productivity and compensation systems.

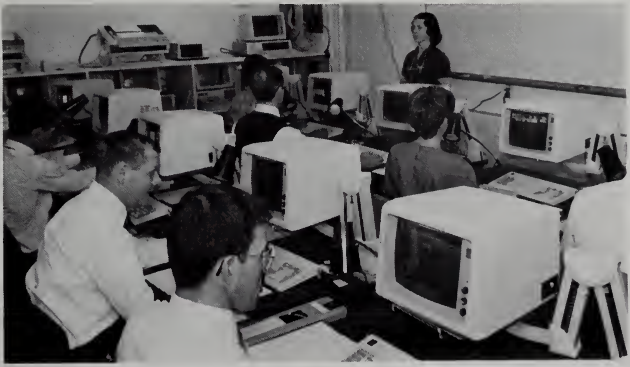
N4900 READINGS IN ADMINISTRATIVE SCIENCE
ariable hours 1-0 to 4-0) (V-0).
individualized program of advanced readings and study in some a of administrative science. PREREQUISITES: A background of vanced work in the area of study and departmental approval. aded on a Pass/Fail basis only.

N4904 MPT RESEARCH APPLICATIONS (0-2).
plications of research techniques to manpower problems. EREQUISITE: MN4106.

N4942 THE STRUCTURE, CONDUCT AND PERFORMANCE
THE DEFENSE INDUSTRIES (4-0).
tudy of selected defense industries' structures (e.g., seller centration, product differentiation, barriers to entry, demand for ducts and buyer concentration), conduct (e. g., pricing policy, duct characteristics policy and policies toward rivals and tomers) and performance (e.g., efficiency, progress and ployment). The government as consumer and regulator. Typical ustries studied are aerospace, computers, shipbuilding and communications. PREREQUISITE: MN3140 or equivalent.

4945 SEMINAR IN ECONOMICS
riable hours 1-0 to 4-0) (V-0).
dy of a variety of topics of current interest in economics, to be ermined by the instructor.

4970 SEMINAR IN ADMINISTRATIVE SCIENCE
riable hours 1-0 to 4-0) (V-0).
dy of a variety of topics of general interest in the administrative nces, to be determined by the instructor. PREREQUISITES: A kground in administrative sciences and permission of the ructor.



DEPARTMENT OF AERONAUTICS AND ASTRONAUTI

Chairman:
E. Roberts Wood,
Professor,
Code AA, Halligan Hall,
Room 139,
(408) 646-2311,
AV 878-2311.

Brij N. Agrawal, Professor of Aeronautics and Astronautics (1989
PhD, Syracuse University, 1970.

Robert E. Ball, Professor of Aeronautics and Astronautics (1967); PhD, Northwestern University, 1962.

Oscar Biblarz, Associate Professor of Aeronautics and Astronauti
(1968); PhD, Stanford University, 1968.

M.S. Chandrasekhara, Adjunct Professor and Assistant Director,
Navy-NASA Joint Institute of Aeronautics (1987); PhD, University
Iowa, 1983.

Daniel J. Collins, Professor of Aeronautics and Astronautics (196
PhD, California Institute of Technology, 1961.

Michael R. Gorman, Associate Professor of Aeronautics and Astronautics (1988); PhD, University of Pittsburgh, 1981.

James V. Healey, Associate Professor of Aeronautics and Astronautics (1983); PhD, University of Southern California, 1969.

Sheshagiri K. Hebbar, Adjunct Professor of Aeronautics and Astronautics (1988); PhD, University of Maryland, 1976.

Garth Hobsen, Associate Professor of Aeronautics and Astronautic
(1990); PhD, Pennsylvania State University, 1990.

Richard M. Howard, Assistant Professor of Aeronautics and Astronautics (1987); PhD, Texas A & M University, 1987.

Ramesh Kolar, Adjunct Professor of Aeronautics and Astronautics (1985); PhD, University of Arizona, 1984.

Gerald H. Lindsey, Professor of Aeronautics and Astronautics (1965); PhD, California Institute of Technology, 1966.

James A. Miller, Associate Professor of Aeronautics and Astronautics (1963); PhD, Illinois Institute of Technology, 1963.

David W. Netzer, Professor of Aeronautics and Astronautics (1968)
PhD, Purdue University, 1968.

Conrad Newberry, Professor of Aeronautics and Astronautics (1990); D.Env., University of California at Los Angeles, 1985.

Eric L. Pagenkopf, Instructor of Aeronautics and Astronautics (1988); MS, Naval Postgraduate School, 1988.

Max F. Platzer, Professor of Aeronautics and Astronautics (1970); Dr. Tech. Science, Technical University of Vienna, Austria, 1964.

I. Michael Ross, Adjunct Professor of Aeronautics and Astronautics (1990); PhD, Pennsylvania State University, 1990.

Louis V. Schmidt, Professor of Aeronautics and Astronautics (1964
PhD, California Institute of Technology, 1963.

ymond P. Shreeve, Professor of Aeronautics and Astronautics
71); PhD, University of Washington, 1970.

Roberts Wood, Chairman and Professor of Aeronautics and
tronautics (1988); D. Eng, Yale University, 1967.

ward Ming-Chi Wu, Professor of Aeronautics and Astronautics
84); PhD, University of Illinois, 1965.

e year of joining the Naval Postgraduate School faculty is indicated in
entheses.

e Department of Aeronautics and Astronautics provides advanced
ication in Aeronautical and Astronautical Engineering to develop
hnical subspecialists in the field. Upper division undergraduate
l graduate courses are offered in aerodynamics, structures, guid-
e and control, flight mechanics, propulsion and design, with appli-
ions to rotary wing and fixed wing aircraft, missiles and spacecraft.

dents specialize in either Aeronautical Engineering (Curriculum
) or Aeronautical Engineering/Avionics (Curriculum 611). The
ree Master of Science in Aeronautical Engineering is offered in
h curricula as well as to select students in Weapons Systems
gineering (Curriculum 530). Students in the 530 curriculum may
o get a Master of Science degree in Engineering Science with option
eronautics. A Master of Science degree in Astronautical Engineer-
is offered to students in Space Systems Engineering (Curriculum
). Selected students may be eligible to pursue the degree Aeronau-
l and Astronautical Engineer or Doctor of Philosophy.

e Department of Aeronautics and Astronautics received a renewal
ts full six (6) year accreditation from the Accreditation Board for
gineering and Technology in 1990.

QUIREMENTS FOR STUDY OF AERONAUTICAL AND TRONAUTICAL ENGINEERING

e entrance requirement for study in the Department of Aeronautics
l Astronautics generally is a baccalaureate in engineering earned
h above-average academic performance. This requirement can
etimes be waived for students who have shown distinctly superior
lity in backgrounds other than engineering, but who have had
quate coverage in the basic physical and mathematical sciences.
entrants must obtain the approval of the Chairman, Department of
onautics and Astronautics.

dents who have not majored in aeronautics, or who have experi-
ed a significant lapse in continuity with previous academic work,
initially take preparatory courses in aeronautical engineering and
hematics at the upper division level, which will extend through
first three academic quarters and constitute a portion of the
rse work for degrees in aeronautics. Final approval of programs
ing to degrees in aeronautical engineering must be obtained from
Chairman, Department of Aeronautics and Astronautics.

ree coverage specifically to be approved includes adequate
ratory and computer experience, graduate-level mathematics and
east one capstone design course.

MASTER OF SCIENCE IN AERONAUTICAL ENGINEERING

The Master of Science degree requires a minimum of 36-credit hours of graduate courses, of which at least 12-credit hours shall be at the 4000 level. It also requires that not less than 32-credit hours shall b in the disciplines of engineering, physical science or mathematics an that this shall include a minimum of 20-hours of courses in the Department of Aeronautics and Astronautics and a minimum of 8 hours in other departments.

An acceptable thesis is required for the degree unless waived by the Chairman, Department of Aeronautics and Astronautics, in which case 10-quarter hours of 4000-level courses in the disciplines of engineering, physical science, or mathematics will be required in addition to those specified above, increasing the total requirements t 46-quarter hours of graduate-level credits.

MASTER OF SCIENCE IN ENGINEERING SCIENCE

Students of the Weapons Systems Engineering curriculum (530) can elect Aeronautics as a specialization option and receive the degree Master of Science in Engineering Science. The program must include at least 36-credit hours of graduate work in engineering, science and mathematics, at least 12 of which must be at the 4000 level. Of thes 36 hours at least 20, including work at the 4000 level, must be in the Department of Aeronautics and Astronautics. Cognizance over the specialization course sequences, thesis research areas and the degree resides with the Chairman, of the Department of Aeronautics and Astronautics.

The program must contain at least 12 hours at the graduate-level in courses other than those presented in the Department of Aeronautics and Astronautics.

The candidate must present an acceptable thesis on the topic given prior approval by the Department of Aeronautics and Astronautics. Final approval of the program leading to the Master of Science in Engineering Science with specialization in Aeronautics shall be obtained from the Chairman of the Department of Aeronautics and Astronautics.

GRADUATE DEGREE IN CURRICULUM 591

Students of the Space Systems Engineering Curriculum (591) can elect specialization in astronautics and receive the Master's degree in Astronautical Engineering. This degree requires, in addition to courses specific to Curriculum 591, at least 20-credit hours of advanced coursework taken in the Department of Aeronautics and Astronautics. A minimum of 36-graduate credits, including at least 12 at the 4000-level and an acceptable thesis, are necessary. Not less than 32-graduate credits shall be in the disciplines of engineering, physical science or mathematics. Final approval of programs leading to this degree must be obtained from the Chairman, Department of Aeronautics an Astronautics.

AERONAUTICAL AND ASTRONAUTICAL ENGINEER

The degree Aeronautical and Astronautical Engineer is offered in the department of Aeronautics and Astronautics and requires a minimum of 72 hours of graduate course credit beyond the ABET (Accreditation Board for Engineering and Technology) requirements for accreditation at the basic level. The degree also requires graduate QPR of 3.5 with ours distributed as follows: at least 39-credit hours must be at the 000 level, of which at least three must be in mathematics; not less han 64-graduate credit hours shall be in the disciplines of ngineering, physical science or mathematics; a minimum of 36 hours ust be in the Department of Aeronautics and Astronautics and at ast 12 hours must be in other departments. An acceptable thesis is quired for the degree and six course equivalents, spread over four uarters, will be allowed in the program for it.

ormal application to work toward the degree must be made to the epartment of Aeronautics and Astronautics prior to commencement thesis research and it is required that the applicant have a raduate QPR of 3.5, an approved program of study, a thesis advisor nd an approved Engineer's Thesis research project.

tudents admitted to work for the degree Aeronautical and stronautical Engineer may be satisfying requirements for the aster of Science in Aeronautical Engineering or the Master of cience in Astronautical Engineering degree concurrently. The spective master's degrees may be conferred at the time of mpletion of the requirements for that degree.

n appropriate allowance will be made for work performed while rning the master's degree at another institution, not to exceed the aximum waivers in required graduate-level courses specified in ction 240, paragraph 3. Final approval of the program leading to e degree Aeronautical and Astronautical Engineer shall be obtained r each student from the Chairman, Department of ronautics and Astronautics.

OCTOR OF PHILOSOPHY AND DOCTOR OF NGINEERING

e Department of Aeronautics and Astronautics fers programs leading to the doctorate in the fields gas dynamics, flight structures, flight dynamics, opulsion, aerospace physics and aerospace vehicle sign.

trance into the doctoral program may be quested by officers currently enrolled who have fficiently high standing. A departmental reening examination will be administered to those requesting. The Department of Aeronautics and tronautics also accepts officer students selected in e Navy wide Doctoral Study Program and civilian idents selected from employees of the United ates Federal Government.

l applicants who are not already enrolled as idents in the Department of Aeronautics and tronautics shall submit transcripts of their previous academic and fessional records to the Director of Admissions Code 62, Naval stgraduate School, Monterey, California 93943. Upon receipt, the plication shall be reviewed by the Aeronautics and Astronautics mmittee for Advanced Studies. Following a successful review, the ndidate is admitted to work toward the engineer's degree as an erim step before being formally admitted to study for the doctorate. soon as feasible, the student shall take a screening examination, ich if successfully completed, will admit him or her to study for the doctorate. A doctoral committee will then be appointed to oversee th student's study and research program.

A noteworthy feature of the program leading to the Doctor of Engineering degree is that the student's research may be conducted away from the Naval Postgraduate School in a cooperating laboratory or other installation of the Federal Government. The degree requirements are outlined in general school requirements for the doctor's degree.

In the event that a student is unable to finally satisfy the above requirements for the doctorate, but has in the course of his or her doctoral studies actually completed all of the requirements for the degree of Aeronautical Engineer, he or she shall be awarded the latte degree.

AERONAUTICAL LABORATORIES

Eight major laboratory divisions support instructional and research programs in subsonic aerodynamics, gas dynamics, rocket and ramjet propulsion, turbomachinery, computer-aided engineering, flight mechanics, structures, composite materials and space systems.

The Subsonic Aerodynamics Laboratory consists of two low-speed wind tunnels and a large continuous-flow visualization tunnel and a 15x20 inch water tunnel. Standard wind tunnel techniques are used in the 32x45 inch and 42x60 inch tunnels and helium bubble filaments are used in the 5x5x12 foot test section of the three-dimensional flow visualization tunnel.

The Gas Dynamics Laboratory includes a 4x4 inch blowdown supersonic wind tunnel, a cold driven, three-inch double-diaphragm shock tube, a 2x2x18 foot open-circuit oscillating flow tunnel and a vertically mounted, supersonic free jet. Laser interferometers, schlieren systems, hot wire anemometry and laser-doppler anemometers are used. Ruby, He-Ne, Argon and CO lasers are available. Extensive use is made of laser holography. An electro-hydrodynamic research facility permits studies of electric power generation, turbulence and fuel sprays into gas turbine combustors.

The Combustion Laboratory consists of an instrumented control room, a propellant evaluation laboratory, a high-pressure air facility and three test cells equipped with diagnostic apparatus and motor hardware for investigating solid, liquid, gaseous and hybrid rocket, solid fuel ramjet and gas turbine combustion. Vitiated air heaters are used to generate temperatures to 1300°F. Several CW and one pulsed laser with holocamera, high-speed motion picture cameras, light scattering and transmission measurement systems, schlieren systems, sampling probes and a dark room equipped for holographic reconstruction and data retrieval are utilized.

The Turbo-Propulsion Laboratory (TPL) houses a unique collection of xperimental facilities for research and development related to ompressors, turbines and advanced air-breathing propulsion engine oncepts. In a complex of specially designed concrete structures, one uilding, powered by a 750 HP compressor, contains 10x60 inch ectilinear and 4 to 8 foot diameter radial cascade wind tunnels and a arge 3-stage axial research compressor for low speed studies. A two-omponent, automated traverse, LDV system is available for CFD ode verification experiments. A second building, powered by a 1250 IP compressed air plant, contains fully instrumented transonic urbine and compressor rigs in explosion proof test cells. A spin-pit or structural testing of rotors to 50,000 RPM and 1800°F is provided. odel experiments and equipment for instrumentation development re located in a separate laboratory. Data acquisition from 400 hannels of steady state and 16 channels of non-steady state easurements at up to 100kHZ is controlled by the laboratory's HP 000 series computer system. On-line reduction and presentation of ata with time sharing terminals are available to multiple users. erminals for HP 9845 and the central IBM 307-3033 computers are vailable for data analysis or flow computation.

he Computer-Aided Design / Computer-Aided Engineering (CAD/ AE) Laboratory has twelve 32-bit networked CAD/CAE orkstations, twenty-four microcomputer systems and two computer-ontrolled data acquisition systems.

he Flight Mechanics Laboratory consists of a general-aviation flight imulator and the Unmanned Air Vehicle Flight Research Laboratory AV FRL). The simulator is used for teaching flight test ngineering. The UAV FRL conducts flight research with scaled adio-controlled aircraft to study problems identified with current eet UAVs and to test new concepts for manned and unmanned ircraft application. Research vehicles include fixed-wing, VTOL and tary wing aircraft. The department's wind tunnels are also used for ircraft performance and stability and control measurements.

he Structural Test Laboratory contains testing machines for static nd dynamic tests of materials and structures and an electrohydraulic osed-loop machine for fatigue testing. Aircraft components as large s an actual aircraft wing are accommodated on a special loading floor here static and vibration tests are conducted. An adjacent strain age and photo-elastic facility provides support to test programs and struction in structural testing techniques.

he Mechanics of Materials for Composites Laboratory is equipped ith fabrication and testing facilities for characterizing the echanical behavior of fiber-reinforced composites. The fabrication cilities include an oven and press with provisions for computer ntrol of temperature and pressure profile for fabrication of minates and strands. The testing facilities include five echanically driven universal testing machines for general testing d for life testing. These testing facilities are supported by a wide ray of modern data acquisition instruments including computer-ntrolled data loggers, digital voltmeters, acoustic emission analyzer d laser diffraction instruments. Personal computers and a VAX-725 ovide ample capacity for analytical interpretation of data and for odel formulation.

The Dynamics and Nondestructive Evaluation Laboratory is equipped for research on vibration of structures, particularly lightweight components for space structures made from composite materials like graphite/epoxy. It contains shaker tables, a four channel FFT analyzer, microcomputers with model analysis software and associated accelerometer instrumentation. For the study of wave propagation in these structures, the laboratory has high-speed transient recorders, narrow and wideband transducers, pulse generators and an arbitrary waveform generator. Static and fatigue loading of samples can be carried out on the 100 kip servo hydraulic MTS machine. The detection of flaw growth during a test can be accomplished using the acoustic emission analyzer. A 2x4 foot ultrasonic C-scan tank can be used for post-test imaging of internal damage. Phase locked loop and quadrature phase detector circuitry allow precise spatial location of flaws. This instrumentation can also be used for very accurate wavespeed measurements.

NAVY-NASA JOINT INSTITUTE OF AERONAUTICS

Through a Memorandum of Understanding with the Ames Research Center (ARC) of the National Aeronautics and Space Administration (NASA), a Joint Institute of Aeronautics was established in July 1986. The purpose of the Institute is to provide NPS students with opportunities to perform their thesis research in an ARC Laboratory, to involve NPS faculty and students in NASA scientific and engineering projects, to develop special courses and seminars for NPS and ARC scientists and engineers to refresh and strengthen professional knowledge at NPS and ARC, and to encourage the enrollment of federal employees for graduate study at NPS with the possibility of performing the thesis research at ARC. Information about research opportunities and admission procedures can be obtained from the Institute Director, Dr. M.F. Platzer, or the Assistant Director, Dr. M.S. Chandrasekhara.

SPACE SYSTEMS LABORATORIES

Laboratories which support the Space Systems programs are located in several departments including Physics, Oceanography and Electrical and Computer Engineering. Refer to the appropriate part of the catalog for descriptions. Aeronautics has developed a Solar Simulator Laboratory which features a 2500W source. Experiments are computer controlled using ISM/PC with ISAAC 2000 controller. Solar cells can be tested for radiation damage using the LINAC or Pulserod sources which are located in Physics. The Laser Damage Facility is a Joint Physics/Aeronautics Laboratory developed to support instruction and research related to such topics as satellite vulnerability. The Laser Damage Facility features a pulsed CO electrical laser with sufficient irradiance to generate laser supported detonation waves. An Optics Laboratory is also available which utilizes lasers for such space functions as remote sensing in addition to precision optical measurements.

COURSE OFFERINGS

AE0020 AERONAUTICAL ENGINEERING PROGRAM PLANNING (NO CREDIT) (0-1).
Oral presentations to students by the Aeronautics department faculty covering thesis research specialty areas.

AE0810 THESIS RESEARCH (0-0).
Every student conducting thesis research will enroll in this course.

AE2015 ENGINEERING DYNAMICS (3-2).
Kinematics and dynamics of particles, systems of particles and rigid bodies in two dimensions; concepts of work, kinetic energy, potential energy, impulse and momentum. PREREQUISITES: MA2121 and ME2501.

AE2021 INTRODUCTION TO FLIGHT STRUCTURES (4-1).
Introduction to concepts of stress and strain and mechanical behavior of materials. Bending and torsional stress and deflection analysis of representative aero-structural components, including statically indeterminate cases. Introduction to stability analysis and energy methods. PREREQUISITE: ME2501.

AE2035 BASIC AERODYNAMICS (3-2).
Continuity/momentum equations; dimensional analysis; elements of two dimensional ideal flow; thin-airfoil, finite wing theory. PREREQUISITE: AE2042.

AE2036 PERFORMANCE AND STATIC STABILITY (3-2).
Model atmosphere; defined airspeeds; aircraft performance including hrust and power required, climb, range, endurance and energy management; principles of longitudinal, lateral and directional static stability and control of aircraft. PREREQUISITE: AE2035.

AE2042 FUNDAMENTALS OF THERMO AND FLUID DYNAMICS (3-2).
Properties of fluids; first and second laws of thermodynamics; entropy nd irreversibilities; equations of state; properties of pure substances. Principles of continuity, momentum and energy for incompressible nd compressible fluids; control power cycles. Viscous flows in ducts; oundary layer concepts; flow separation and drag.

AE2043 FUNDAMENTALS OF GAS DYNAMICS (3-2).
Concepts of compressible flows, adiabatic/isentropic flow; normal hocks, moving and oblique shocks, Prandtl-Meyer flow; Fanno and Rayleigh flow; introduction to reaction propulsion systems. PREREQUISITE: AE2042.

AE2440 INTRODUCTION TO DIGITAL COMPUTATION (3-2).
ntroduction to the use of the digital computer in aeronautical ngineering. Computer architecture, operating systems and the need r high level languages are examined. VM/CMS on the mainframe nd MS-DOS on the personal computer are introduced as examples of perating systems. FORTRAN is introduced as an example of a high evel programming language. Development of complete input/output perations is stressed. Numerous editors and utility programs are oupled with FORTRAN programming to permit the student to solve epresentative problems in aeronautical engineering.

AE2801 AERO-LABORATORIES (3-2).
An introduction to modern experimental techniques and instrumentation. Lectures and demonstrations in the use of sensing devices and data acquisition systems, data reduction and analysis, report writing. Selected experiments in all aeronautical laboratories. PREREQUISITES: AE2021, 2035, 2043 and 2015 (concurrent) or equivalent.

AE2820 INTRODUCTION TO SPACECRAFT STRUCTURES (Intended for Curriculum 591). (3-2).
Loads criteria for space vehicles-launch, on-orbit, maneuver and thermal. Field Equations- strain-displacement, equilibrium and constitutive equations. Materials for space structures. Design criteria. Structural modeling of large flexible space trusses and other components. Analysis of typical members.

AE3005 SURVEY OF AIRCRAFT AND MISSILE TECHNOLOGY (Intended for Non-Aero. Engineering Students). (4-0).
A survey of aeronautical engineering concepts as applied to airplanes and missiles, starting with explanations of the basic principles of aerodynamics, performance, propulsion, etc. and extending to examples of these principles in present-day hardware.

AE3101 FLIGHT VEHICLE STRUCTURAL ANALYSIS (3-2).
A graduate core course in structures covering three dimensional field equations for solid bodies; normal and shear stress analysis of monocoque and semi-monocoque beam structures made of multiple materials and subjected to mechanical and thermal loads; work and energy methods of analysis. PREREQUISITE: AE2021.

AE3251 AIRCRAFT COMBAT SURVIVABILITY (4-2).
This course brings together all of the essential ingredients in a study of the survivability of fixed wing and rotary wing aircraft in a hostile (non-nuclear) environment. The technology for increasing survivability and the methodology for assessing the probability of survival in a AAA/SAM/Laser environment are presented in some detail. Topics to be covered include: current and future threat descriptions; the mission/threat analysis; combat data analysis of SEA and Mid-East losses; vulnerability reduction techniques and technology for the major aircraft systems; susceptibility reduction concepts and equipment for reducing the probability of detection and avoidance of the threat; and vulnerability, susceptibility and survivability assessment and trade-off methodology. In-depth studies of the survivability of several fixed wing and rotary wing aircraft will be presented. (May be taken for 3 credits through Continuing Education as AE3250). PREREQUISITES : U.S. citizenship and SECRET clearance.

AE3276 INTRODUCTION TO AVIONICS (3-2).
This course examines the concepts of synchros, servo motors, gyros, compass systems; navigational systems, including TACAN, radio altimeter and inertial guidance systems; air data systems, autopilots and flight directors. Avionics concepts will be described in both analog and digital formats; data bus architecture, failure mode analysis, software validation, environmental and maintenance considerations.

E3340 DYNAMIC STABILITY OF AEROSPACE EHICLES (3-2).

ree and forced response of physical systems; eigenvalue problem olutions for damped/undamped systems. Stability derivatives ncluding the effects of elasticity; aircraft equations of motion; state ariable solutions for uncoupled and cross-coupled cases. REREQUISITES: AE2015, AE2036.

E3341 CONTROL OF AEROSPACE VEHICLES (3-2).

lassical control theory including Bode, Nyquist and root-locus oncepts as applied to aircraft, missiles and space structures. Auto-ilot design and stability augmentation using modern control theory p to observer theory concepts. The effect of noise excitation on ontroller design with emphasis on aircraft gust response. REREQUISITE: AE3340.

E3451 AIRCRAFT AND MISSILE PROPULSION (3-2).

ntroduction to solid rocket propulsion including propellant selection nd performance and nozzle flow analyses. Description, design riteria, on-and off-design cycle analysis and performance of ramjets, rboprops, turbojets and turbofans. Analysis of components: inlets, mpressors, combustors, turbines, afterburners and nozzles. Current ate of the art and impact of trends in propulsion technology. REREQUISITE: AE2043.

E3501 AERODYNAMIC ANALYSIS (3-2).

troduction to aerodynamic analysis methods for subsonic and personic flight vehicles. Developments proceed from the three-mensional Navier-Stokes equations to various approximation ethods for linearized, inviscid, subsonic and supersonic flows over rfoils and wings; discussion of sweep-back effects and area ruling; troduction to DATCOM methods; laminar and turbulent boundary yer analysis; use of computer programs based on panel, rtexlattice and other methods. PREREQUISITES: AE2043, AE2035, A3132.

E3701 MISSILE AERODYNAMICS (4-1).

tential flow, thin-airfoil and finite wing theories. Linearized quations, Ackeret theory, Prandtl-Glauert transformations for bsonic and supersonic wings. Planform effects. Flow about slender dies of revolution, viscous crossflow theory. PREREQUISITE: E2043.

E3705 AIR DEFENSE LETHALITY (4-1).

is course examines the design and effectiveness of anti-aircraft ns and missiles, both surface based and airborne. The techniques d procedures for target detection, target tracking and propagator yout (both guided and ballistic) are presented and quantified. Target gnatures for radar, IR and visually directed systems are examined. e types of warheads and fuzes on small arms, anti-aircraft artillery d guided missiles are presented. The vulnerability of the target to e damage mechanisms is examined and the procedures for assessing e measures of target vulnerability are described. Total system thality is evaluated by determining the probability of target kill ven a single shot and given an encounter. Countermeasures used by e target for reducing the air defense lethality are also described.

AE3802 AERONAUTICAL MEASUREMENT TECHNIQUES (3-3)
This course is intended to introduce the student to aeronautical measuring techniques and test facilities used by NASA and the aerospace industry during the research, development and testing phase (RDT&E) of aircraft and missile systems. Applications of laser doppler velocimetry, hot wire instrumentation, flow visualization methods and modern data acquisition systems will be demonstrated. Field trips to NASA Ames Research Center will be arranged to show how the advanced techniques and facilities are applied to solve real-world problems in aeronautics. PREREQUISITE: AE2801.

AE3804 THERMAL CONTROL OF SPACECRAFT
(Intended for curriculum 591) (3-0).
Fundamentals of thermal radiation. Vehicle equilibrium temperature Effects of coatings and of orbit, on vehicle temperature; the transient case (earth shadow). Heat rejection systems: free-space and non-free-space. Weight optimizations. Effect of manifolds. Design and synthesis examples. PREREQUISITE: AE2840.

AE3811 SPACE SYSTEMS LABORATORY
(Intended for curriculum 591) (1-2).
This course consists of lectures on basic principles of spacecraft testing and experiments on spacecraft sinusoidal testing, random testing, thermal vacuum testing, FLTSATCOM closed loop attitude control testing and selected spacecraft system functional testing.

AE3815 INTRODUCTION TO SPACECRAFT DYNAMICS
(Intended for curriculum 591) (4-0).
Rotating coordinates; orientation angles. Velocities, accelerations; motion equations. Attitude stabilization considerations. Three axis control. PREREQUISITES: AE2015 and AE2820.

AE3850 PROPULSION FOR LAUNCH VEHICLES (4-0).
Introduction to propulsion for launch vehicles, beginning with missio energy requirements and an overview of current and proposed launch propulsion devices. Performance analysis, operating characteristics and propellant selection criteria are considered for airbreathing and solid, liquid and nuclear rocket motor propulsion systems. PREREQUISITES: AE2042, AE2043.

AE3851 SPACECRAFT PROPULSION (3-2).
This course introduces concepts and devices in spacecraft propulsion. It reviews fundamental fluid mechanics, electricity and magnetism and thermodynamics with molecular structure. Conventional chemica means such as H2/O2 and monopropellants are discussed. Electric propulsion schemes (resistojets, arc-jets, ion, magneto-plasma-dynamic, etc.) are introduced and their performances contrasted with chemical schemes. Characteristics of more advanced concepts (laser, microwave, solar, thermal, etc.) are also considered. PREREQUISITE: AE3850.

AE3900 SPECIAL TOPICS IN AERONAUTICS
(Variable hours 1-0 to 5-0) (V-0).
Directed graduate study or laboratory research. Course may be repeated for additional credit if topic changes. PREREQUISITE: Consent of department Chairman.

E4000 AERONAUTICAL ENGINEERING SEMINAR (1-0).

ral presentations on subjects not covered in formal courses, which reat a wide spectrum of topics ranging from reports of current esearch to survey treatments of Navy issues and problems of cientific and engineering interest.

E4102 FINITE ELEMENT ANALYSIS OF FLIGHT EHICLES (3-2).

he finite element method of structural analysis is formulated and pplied to aircraft, missile and space structures. Element properties or bars, frames, membranes, plates/shells and three dimensional olid elements are discussed. Structural idealization, modeling and nterpretation of results are presented. Capabilities of commercial inite element codes and pitfalls of computation are reviewed. Basics f nonlinear analysis are presented. PREREQUISITE: AE3101.

E4103 MECHANICS OF COMPOSITE MATERIALS (3-2).

course covering the mechanics of multi-phased composite materials. rediction of composite properties from the constituent of fiber/matrix roperties. Design of composite structural components including aminates and sandwich construction. Fabrication and manufacturing echniques. Survey of strength theory, damage and repair. REREQUISITE: AE3101.

E4201 RELIABILITY ENGINEERING AND SYSTEM SAFETY ANAGEMENT (4-0).

n introduction to System Safety based on the foundations of tatistical sampling and probability modeling with applications to nilitary standard requirements. Mathematical foundations probability, set theory, Boolean algebra, distribution functions); eliability testing (experimental planning via Monte Carlo imulations, parameter estimation); safety analysis (hazard analysis, ault-tree analysis, monolithic and redundant components) safety riteria and life cycle considerations.

Flying in the Navy had been a dream of **Lieutenant Lori J. Melling** since she was 19, and it was the stories of a Marine Corp test pilot/astronaut that spurred her into joining the Navy. Melling, an A-7 pilot, was one of ten people selected each year to attend NPS under the Naval Postgraduate School/Test Pilot School Cooperative program. As part of the program, Melling will spend 15 months at NPS, followed by 12 months at the Naval Test Pilot School in Maryland. With undergraduate degrees in both Mechanical Engineering and Theoretical and Applied Mechanics from Michigan State University, Melling feels the NPS/TPS co-op program has allowed her to "combine the worlds of test flying and engineering."

After completion of the co-op program, Melling will obtain her Master's degree in Aeronautical Engineering along with her designation as a Navy Test Pilot. After that, she will remain in Patuxent River, MD, as a test pilot.

AE4202 RELIABILITY OF COMPOSITE MATERIALS (3-2).
A course covering the reliability engineering of composite materials n critical structural applications. Probability modeling of strength of composites, prediction of geometric size effect, development of standards for specification and acceptance. Reliability assurance methodology, proof-test, life predictions. Structure reliability unde combined state of stress, damage repair and inspections. PREREQUISITE: AE4201.

AE4273 AIRCRAFT DESIGN (3-2).
A course in conceptual design methodology which centers around ar individual student design project. It draws upon all of the aeronaut disciplines and provides the student with experience in their application to design. PREREQUISITES: AE2035, AE2036, AE3451

AE4276 AVIONICS SYSTEM DESIGN (3-2).
Course will develop digital control concepts for aircraft applications methodology of designing a digital flight control system for a high performance aircraft; review of sensor and actuator characteristics. detailed case study of a digital flight control system will be perform by students. PREREQUISITE: AE4342.

AE4304 HELICOPTER DYNAMICS AND AERODYNAMICS (3-
Aerodynamics of helicopters. Hover and vertical flight. Actuator dis momentum theory, blade element theory, tip loss, rotor flow states, autorotation, hover and forward flight analysis and performance analysis. Helicopter dynamics, rotor bla motion and control, vibrations, rotor as filter, coupled blade-fuselage response, mechanical and aerodynamic instabiliti vibration control devices, higher harmo control, rotor acoustics accounting for rotational, vortex and BVI noise.

AE4305 V/STOL AIRCRAFT TECHNOLOGY (3-2).
Types of V/STOL aircraft, fundamental principles, main performance characteristics and propulsion requirements; STOL technology: mechanical high-lift devices, powered-li devices, jet flaps, augmentor wings; VT technology: flow vectoring devices, lift engine and lift fan technology, augment wings, airframe/propulsion system interactions, ground interference effects V/STOL stability and control considerations, handling qualities; review of current NAVY V/STOL requirements and programs. PREREQUISITES: AE3501, AE3451, AE3340.

AE4306 HELICOPTER DESIGN (3-2).
Design of a helicopter to meet given mission requirements. Students participate with instructor and visiting guest lecturers in helicopter design process. Topics include rotor dynamics, selected subjects in helicopter design, design lessons learned from AH-64 “Apache,” helicopter vibrations, handling quality requirements, dynamic NASTRAN, survivability/killability, Navy driven design requirements, Navy rotocraft into 21st century and lessons from Soviet helicopter technology. PREREQUISITE: AE4304.

E4317 FLIGHT VEHICLE STRUCTURAL DYNAMICS (4-0).

esponse of single and multi degree-of-freedom systems; vibrations of ds and beams. Finite element formulation for structural dynamics oblems in fixed-wing and rotary wing rcraft, flexible spacecraft and large space ructures. Computational methods for dynamic sponse. Introduction to nonlinear vibrations and aos. PREREQUISITES: MA2121, MA2047.

E4318 AEROELASTICITY (4-0).

esponse of discrete and continuous elastic ructures to transient loads and to steady oscillatory ads. Static aeroelasticity, non-stationary airfoil and ng theory. Unsteady missile aerodynamics. pplication to the flutter problem. Transient loads, sts, buffet and stall flutter. PREREQUISITE: E3340.

E4323 FLIGHT TEST ENGINEERING (3-2).

ight test analysis for pilot-static calibration, cruise d climb performance, stall testing, longitudinal atic and dynamic stability, maneuvering stability, teral-directional stability, transonic flying qualities d helicopter flight testing. Includes a week-long in- ght laboratory.

E4342 ADVANCED CONTROL FOR EROSPACE SYSTEMS (3-2).

near optimal control, Kalman Filter techniques. ements of H2 and H-infinity design applied to modern tactical ghters and spacecraft structures. Topics may include: sliding mode ntrollers, distributed controllers and/or adaptive estimators. EREQUISITE: AE3341.

E4343 GUIDED WEAPON CONTROL SYSTEMS (3-2).

tailed analysis of tactical missiles, performance of target trackers, sic aerodynamics of missiles, missile autopilot design, missile rvos and instruments, line-of-sight guidance loops, terminal idance, proportional navigation. PREREQUISITE: AE3341 or uivalent.

E4431 TURBOMACHINES: ANALYSIS, DESIGN AND XPERIMENT (3-2).

e underlying principles governing flow through and energy change in compressors and turbines are developed to provide a sis for understanding both design and current analysis methods. y considerations and procedures followed in the design of aircraft gine compressors and turbines are described and current mputational methods of analysis are introduced. Lectures are ordinated with experimental experience at the Turbopropulsion boratory. PREREQUISITE: AE2043.

E4451 AIRCRAFT ENGINE DESIGN (3-2).

e design process, aircraft-engine constraints, mission constraints, -design and off-design cycle analysis, engine sizing for installed rformance, component designs (fans, compressors, turbines, rners, inlets, exhaust nozzles). PREREQUISITE: AE3451.

AE4452 TACTICAL MISSILE PROPULSION (4-0).
Applications and analysis of solid propellant rockets, ramjets, dual-mode ramjets and ducted rockets. Propellant selection criteria and characteristics, combustion models and behavior, performance analysis, combustor design, combustion instabilities and damping, mission and flight envelope effects on design requirements and technology requirements. Introduction to insensitive munitions and plume signature considerations. PREREQUISITES: AE2042 or PH2724, AE2043.

AE4502 HIGH-SPEED AERODYNAMICS (4-0).
Transonic aerodynamics; numerical solutions to potential equations airfoil analysis; shock-capturing. Method of characteristics; development of system of partial differential equations. Numerical problems in transonic and supersonic flows. PREREQUISITE: AE3501.

AE4503 MISSILE AERODYNAMICS (4-0).
The aerodynamics of missiles and guided projectiles for various spe regimes and motions. Topics include slender body and linearized theory as well as nonlinear aerodynamic effects, coupling effects, Magnus effects, etc. The impact of these effects on missile flight dynamics, guidance and control is included. PREREQUISITE: AE3501.

AE4504 CONVECTIVE HEAT AND MASS TRANSFER (4-0).
Convective heat and mass transfer in laminar and turbulent flows. Analytic techniques, integral and numerical methods, experimental correlations. Effects of variations in thermophysical properties. PREREQUISITE: AE3501.

AE4505 LASER/PARTICLE BEAM TECHNOLOGIES (3-2).
Elements of lasers and particle beams are presented together with survey of their technologies. High energy lasers, including electrica gas dynamic, excimer and chemical lasers, as well as electron beam are typically treated. Concepts in beam management, propagation a damage mechanisms are discussed. Current military applications ar future trends are covered as special topics. PREREQUISITE: AE204

AE4506 RAREFIED GAS DYNAMICS (4-0).
Topics include advanced thermodynamics with molecular structure, kinetic theory, distribution functions, Boltzmann equation and transport phenomena from a kinetic theory point of view. Types of flow range from free-molecule to transition, to high temperature continuum. Numerical approaches are discussed. PREREQUISITES: AE2042, AE3501 and AE4632.

AE4507 COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER (3-2).
The emphasis will be on the numerical solution of sets, of partial differential equations, that describe fluid flow and heat transfer. Th governing equations for fluid dynamics are reviewed and turbulence modelling is introduced. Discretization techniques are applied to selected model equations and numerical methods are developed for inviscid and viscous, compressible and incompressible flows. PREREQUISITE: AE4632.

4632 COMPUTER METHODS IN AERONAUTICS (4-0).
umerical methods in Aeronautical Engineering problems. Computer ution procedures for ordinary and partial differential equations. EREQUISITES: AE2440, MA3132.

4641 AERONAUTICAL DATA SYSTEMS (3-2).
design-project-oriented course utilizing microprocessor technology th emphasis upon aeronautical engineering applications. Both ftware and hardware aspects of system integration will be nsidered for engineering tradeoffs during problem definition and ution. PREREQUISITE: EC2170 or equivalent.

4650 PARALLEL DISTRIBUTED PROCESSING (NEURAL TWORKS) (4-0).
alysis of paradigms associated with neural networks using tensive computer software to test and develop applications. The in emphasis of the course is to develop an understanding of neural tworks and the applications of neural network techniques to a riety of problems including image identification. EREQUISITE: Consent of instructor.

4703 MISSILE FLIGHT ANALYSIS (Intended r Non-Aero Engr. Students) (4-1).
ability and control. Configuration determinants. ansient (dynamic) modes. Subsonic, transonic, personic force and moment data for performance culations with short and long-range cruciform ssiles and cruise missiles: acceleration, climb, ceiling, nge and agility in maneuvering trajectories. EREQUISITE: AE3701

4704 MISSILE SYSTEMS INTEGRATION (3-2).
project-oriented course developing micro-computer nulation of flight trajectories and target intercepts, using on tradeoffs among propulsion requirements, loads, sensors, guidance laws, controls and uctural components. PREREQUISITES: AE4702 and 03 or equivalent.

4712 SURVEY OF TACTICAL MISSILE STEMS (Intended for Non-Aero Engr. udents) (3-2).
erview of missile technology: air loads, propulsion, idance and control, sensors. Simple trajectory alysis. Performance tradeoffs.

4816 DYNAMICS OF FLEXIBLE SPACE STRUCTURES ntended for curriculum 591) (4-0).
aracterization of periodic and random structural vibrations countered in space systems. Physical coordinates and modal ordinates. Mass, stiffness and damping matrices. Single degree-of-edom and multiple degree-of-freedom systems. Forced response alysis. The general mobility matrix. System identification by input-tput relations. Random excitation and autospectral density. oblems associated with parameter estimation. Introduction to nlinear systems.

AE4818 SPACECRAFT ATTITUDE, DYNAMICS AND CONTROL (4-0).
This course covers effects of energy dissipation on attitude stability, dynamic effects of liquified motion, spacecraft disturbance torques, active mutation control of spin-stabilized spacecraft, attitude sensor three-axis stabilization, fixed momentum wheel system, skewed momentum wheel/reaction wheel system, structural flexibility/contro interactions, modal observability controllability, modal truncation and attitude control design examples. PREREQUISITE: AE3815.

AE4830 SPACECRAFT SYSTEMS I (Intended for curriculum 366) (3-2).
Examination of the factors affecting space systems selection and design, impact of orbital and sensor characteristics, ground facilities requirements, manufacturing, testing and verification techniques an requirements. Payload design considerations including impact of antennas. RF environment and EMI. Mechanical and electrical desig of space systems. Temperature control. Attitude control. Special techniques associated with large space structures. PREREQUISITES PH3514, completion of Space Engineering Core Curriculum or equivalent.

AE4831 SPACECRAFT SYSTEMS II (Intended for curriculum 366) (4-0).
Survivability of space systems in wartime is discussed along with design features to improve protection. Case studies are selected to emphasize and illustrate material presented previously in AE4830 as well as material in AE4831. The students design a space system to meet mission requirements. PREREQUISITE: AE4830.

AE4844 HYPERSONIC FLIGHT (4-0).
Characteristic features of flow over re-entry and hypersonic flight vehicles. Effects of Mach number, high enthalpy and low density. Analysis and computational methods for blunt and slender bodies and for practical vehicle shapes. Ground simulation of re-entry and sustained flight environments. The hypersonic air-breathing vehicle. PREREQUISITES: AE2035 and AE2043.

AE4870 SPACECRAFT DESIGN AND INTEGRATION (Intended for curriculum 591) (4-0).
This course concentrates on the overall design aspects of the spacecraft bus. Emphasis is on the integration of sub-systems, test procedures and space qualifications to meet specific mission requirements. PREREQUISITE: Completion of Space Engineering Curriculum Core or equivalent.

AE4871 SPACECRAFT DESIGN AND INTEGRATION II (Intended for curriculum 591) (4-0).
A design-project course concentrated on detailed application of design of spacecraft bus sub-systems, including hardware selection and location and integration into spacecraft configuration. PREREQUISITE: AE4870.

AE4900 ADVANCED STUDY IN AERONAUTICS (Variable hours 1-0 to 5-0) (V- 0).
Directed graduate study or laboratory research. Course may be repeated for additional credit if topic changes. PREREQUISITE: Consent of department Chairman.

TISUBMARINE WARFARE ACADEMIC GROUP

ert Hathaway Bourke, Associate Professor of Oceanography 1)*; BS, Naval Academy, 1960; MS, Oregon State University, ; PhD, Oregon State University, 1972.

Berchard Coppens, Associate Professor of Physics (1969); B. Cornell University, 1959; MS, Brown University, 1962; PhD, ell University, 1965.

es Norfleet Eagle, II, Associate Professor of Operations arch (1973); PhD, Stanford University, 1975.

eagle Forrest, Professor (1964); BS, University of Oregon, 1950; University of Oregon, 1952; PhD, University of Oregon, 1959.

es Vincent Sanders, Associate Professor of Physics (1961); BS, State University, 1954; PhD, Cornell University, 1961.

rles William Therrien, Associate Professor (1984); SB and SM, sachusetts Institute of Technology, 1965; PhD, Massachusetts itute of Technology, 1969.

Robert Washburn, Professor (1970); PhD, Carnegie Institute chnology, 1965.

year of joining the Naval Postgraduate School faculty is indicated in ntheses.

Chairman:
R. Neagle Forrest,
Professor,
Code AW, Root Hall,
Room 267,
(408) 646-2653,
AV 878-2653.

demic Associate:
es Sanders, Associate Professor,
PH/Sd, Spanagel Hall, Room 146B,
) 646-2931, AV 878-2931.

Antisubmarine Warfare Academic Group is an association of lty members representing separate academic disciplines. An emic group is a less formal organization than an academic rtment and each professor in the group has an appointment in an emic department. The Antisubmarine Warfare Academic Group administrative responsibility for the academic content of the submarine Warfare program of study. Teaching in this idisciplinary program is carried out by faculty members attached e following academic departments: trical and Computer Engineering, hematics, National Security Affairs, nography, Operations Research and sics. Thesis topics for students in this of study are approved by the group the final thesis is approved by the rman.

TER OF SCIENCE IN APPLIED ENCE

degree Master of Science in Applied nce will be awarded at the completion e multi-disciplinary program.

entire program must be approved by hairman of the Antisubmarine fare Group.

COURSE OFFERINGS

ST0001 SEMINAR (0-1).
Special lectures and discussion of matters related to the ASW Program. PREREQUISITES: Enrollment in the ASW Curriculum and SECRET clearance.

ST0810 THESIS RESEARCH/GROUP PROJECT (0-0).
Students in the ASW Curriculum will enroll in this course while doing either an individual thesis or an equivalent group project involving several students and faculty.

ST3000 STUDY PROJECT ON ASW SYSTEMS PERFORMANCE (0-2).
This is a project course in which the project is a study and analysis of the performance of an assigned type of ASW system under a variety of operating conditions. PREREQUISITES: Enrollment in the ASW Curriculum or consent of the group Chairman and SECRET clearance Graded on a Pass/Fail basis only.

ST4999 SPECIAL STUDIES IN ASW
(Variable hours 1-0 to 4-0) (V-0).
A course designed to meet the needs of students for special work in advanced topics related to ASW. PREREQUISITE: Enrollment in the ASW curriculum and consent of the group Chairman.

ichard J. Toft, Captain, U.S. Navy; Director (1990); BS, Rutgers niversity, 1962.

ilton Harold Bank, II, Associate Professor of Aeronautical ngineering and Safety (1971)*; PhD, Georgia Institute of chnology, 1971.

ana D. Barclay, Lieutenant Commander, U.S. Navy; Instructor in ishap Investigation (1988); MSSM, University of Southern alifornia, 1987.

thony P. Ciavarelli, Jr., Associate Professor of Psychology 989); Ed.D., University of Southern California, 1987.

obert C. Figlock, Lieutenant Colonel, U.S. Marine Corps; structor in Aviation Safety Information Management (1989); SSM, University of Southern California, 1982.

dward John Kennedy, Adjunct Professor of Aviation Physiology 972); MD, University of Iowa College of Medicine, 1962.

obert D. Moran, Captain, U.S. Marine Corps; Instructor in Rotary ing Aerodynamics (1990); AE, Naval Postgraduate School, 1990.

harles W. Nation, Jr., Commander, United States Navy; Instructor Aviation Safety Programs (1989); BS, U.S. Naval Academy, 1969.

harles D. Pickett, Captain (Medical Corps), U.S. Navy; Assistant ofessor of Aeromedical Aspects of Safety (1987); DO, College of steopathic Medicine, University of Health Sciences, Kansas City, issouri, 1962.

onald Fred Rygg, Lieutenant Commander, U.S. Navy; Instructor Mishap Investigation and Aviation Safety Information anagement (1988); BA, California Lutheran College, 1972.

ewart Wayne Schreckengast, Commander, U.S. Navy; Instructor Fixed-Wing Aerodynamics (1988); MSAE, Naval Postgraduate hool, 1979.

ank P. Yasment, Commander, U.S. Navy; Instructor in Mishap porting (1989); MBA, National University, 1985.

The year of joining the Naval Postgraduate School faculty is indicated in rentheses.

VIATION SAFETY OFFICER COURSE

Aviation Safety Officer (ASO) course is offered seven times each ar on a temporary additional duty basis for those commands eding an Aviation Safety Officer. This course prepares the graduate assist his or her commanding officer in conducting an aggressive shap prevention program. When the ASO completes the course he she will be able to organize and administer a mishap prevention ogram at the squadron level as defined in OPNAVINST 3750.6.

is twenty-eight day course consists of approximately 146 classroom d laboratory hours, plus a two-day field trip. Subjects addressed in e classroom and laboratory include safety programs, mishap prevention techniques, operational aerodynamics and aerostructures, mishap investigation and reporting, psychology, safety law and aeromedical support. During the field trip a safety survey of an operating squadron is made by the students.

Prior completion of college-level courses in algebra and physics is highly desirable for the prospective student.

Designated naval aviators and naval flight officers of the Navy and Marine Corps in the rank of Lieutenant, (USN) and Captain, (USMC) and above are eligible to attend. Exceptions must be approved by Type Commanders or CMC, as appropriate. Details of quota control and class schedules are defined in NPSNOTICE 1520.

Resident Students
Officers regularly enrolled in other curricula of the Naval Postgraduate School may qualify for the Aviation Safety Officer Certificate by completing these required courses: AO2020, AO2030, AO3000, AO3010 and AO3040. Substitutions of equivalent courses taken in other departments for some of these courses may be made upon approval of the Director of Aviation Safety Programs. For example, AO2020 may be replaced by upper division or graduate courses in aeronautical engineering which cover the essential subject matter of the course.

AVIATION SAFETY COMMAND COURSE

An Aviation Safety Command (ASC) course is offered eight times each year on a temporary additional duty basis to commanding officers, executive officers, officers in charge of aviation detachments, officers screened for command and staff officers in the rank of Lieutenant Commander, USN, Major, USMC and above. This course is designed to provide information which will assist commanding officers in conducting an aggressive mishap prevention program and to prepare the graduate for the duties of Senior Member of a Mishap Board.

The course consists of approximately 34 classroom and laboratory hours addressing subjects including safety programs, safety psychology, aviation law, aircraft systems, mishap investigation, mishap and incident reports and endorsements and aerospace medicine.

No academic credit is given for this course.

OURSE OFFERINGS

02020 AERODYNAMICS FOR AIRCRAFT ACCIDENT REVENTION AND INVESTIGATION (2-0).

ırvey of aerodynamics, performance, stability and control, with nphasis on pre-mishap hazard identification and risk management. ffects of varying designs, configurations, atmospheric conditions, ew techniques and degraded aircraft capabilities on critical areas of eration are discussed and related to current mishap experience. troduction to current aircraft technology and future design nsiderations. (Taught in separate rotary-wing and fixed-wing ctions).

02030 AIRCRAFT STRUCTURAL ANALYSIS (1-0).

ındamentals of strength of materials, design criteria, and theories failure. Buckling. Effects of stress concentrations; fatigue process. entification of static and fatigue fractures. Introduction to mposite materials technology.

03000 MANAGEMENT OF ACCIDENT PREVENTION ROGRAMS (2-1).

anagement theories and practices with emphasis on planning, ading, organizing and controlling. Automatic data-processing stems and analysis of accident statistics. Organizational fectiveness theory and techniques as applied to Navy safety ograms. Systems safety theories and techniques applied to hazard tection, analysis, and elimination. Group dynamics and human havior. Applied theory exercise in hazard detection survey chniques at selected naval aviation organizations.

3010 SAFETY INFORMATION MANAGEMENT (2-1).

chniques of mishap investigation and reporting. Introduction to gic, including deductive and inductive reasoning. Witness terviewing techniques. The legal doctrine of Safety Privilege. ganization and administration of investigative boards and mmissions. Through case studies, laboratory and field exercises, the urse provides practical experience in investigating and reporting nulated aircraft mishaps.

3040 SAFETY PSYCHOLOGY AND PHYSIOLOGY (2-0).

ychology of high-performance groups; human reliability in survival- lue environments; personality elements in safety motivation; risk- king behavior. The effects of physical and mental/emotional stress the physiology and performance of aviation personnel. Techniques identifying and dealing with marginal aviators.

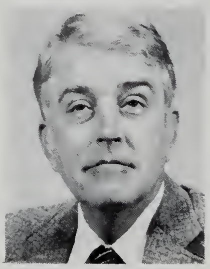
3100 MANAGEMENT OF ACCIDENT-PREVENTION ROGRAMS (3-2).

anagement theories, practices, communications and controls; tomatic data-processing and analysis of accident statistics; legal nsideration in safety management; use of systems safety in hazard entification.

3120 TECHNOLOGICAL ASPECTS OF ACCIDENT- REVENTION AND ANALYSIS (3-2).

pics include case studies of technological design-related aviation shaps; identification of structural failure modes; computer and nulator methods in aeronautics; safety related problems of Navy apons systems evaluation and acquisition.

COMMAND, CONTROL & COMMUNICATION (C3) ACADEMIC GROU



Chairman:
Carl R. Jones, Professor,
Code CC, Spanagel Hall,
Room 203,
(408) 646-2618,
AV 878-2618.

Dan Calvin Boger, Associate Professor of Economics (1979)*; PhD, University of California at Berkeley, 1979.

R. Mitchell Brown, III, Commander, U.S. Navy; Chair of Strategic Planning (1989); MA, Naval Postgraduate School, 1980.

William J. Caldwell, Lieutenant Colonel, U.S. Army; Instructor (1989); MS, Naval Postgraduate School, 1979.

Kenneth L. Davidson, Professor (1970); PhD, University of Michigan, 1970.

Daniel Roy Dolk, Associate Professor of Management Information Systems (1982); PhD, University of Arizona, 1982.

Donald Paul Gaver, Jr., Distinguished Professor (1956); PhD, Princeton University, 1956.

Thomas E. Halwachs, Commander, U.S. Navy; Director of Wargaming, Operations Analysis (1985); MS, Naval Postgraduate School, 1976.

Wayne Philo Hughes, Jr., Adjunct Professor (1979); MS, Naval Postgraduate School, 1964.

Carl Russell Jones, Chairman and Professor (1965); PhD, Claremont Graduate School, 1965.

Donald A. Lacer, C3 Chair Professor (1988); MS, University of California at Los Angeles, 1964.

Gordon Eric Latta, Professor (1979); PhD, California Institute of Technology, 1951.

Michael Melich, Professor (1983); PhD, Rice University, 1967.

Paul Henry Moose, Associate Professor (1980); PhD, University of Washington, 1970.

Samuel Howard Parry, Associate Professor (1972); PhD, Ohio State University, 1971.

Gary Kent Poock, Professor (1967); PhD, University of California at Berkeley, 1967.

Thomas A. Schwendtner, Captain, U.S. Air Force; Instructor (1989); MS, University of Colorado, 1989.

Michael Graham Sovereign, Professor (1970); PhD, Purdue University, 1965.

James Grover Taylor, Professor (1989); PhD, Stanford University, 1966.

Allan W. Tulloch, Commander, U.S. Navy; Instructor (1989); MS, Naval Postgraduate School, 1972.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

The Command, Control and Communications (C3) Academic Group is an interdisciplinary association of faculty. An academic group is a less formal organization than an academic department and each professor in the group has an appointment in an academic department. The C3 Academic Group has responsibility for the academic content of the Joint Command, Control and Communications curriculum and a C3 research program. Thesis topics are approved by the group and the final thesis is approved by the Chairman.

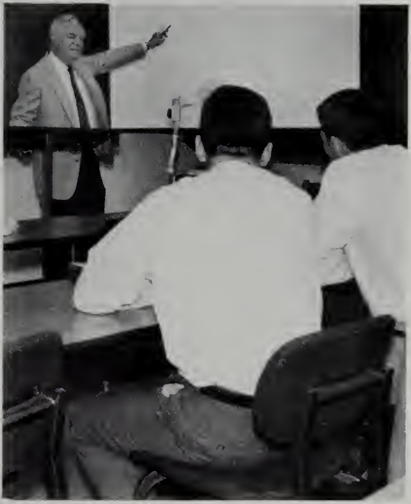
MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY

The degree Master of Science in Systems Technology (Command, Control and Communications) will be awarded at the completion of an interdisciplinary program carried out in accordance with the following degree requirements.

The Master of Science in Systems Technology (Command, Control and Communications) requires a minimum of 45-quarter hours of graduate level work in four different academic disciplines, of which at least 15 hours must represent courses at the 4000 level in at least two of the disciplines. Within the course program there must be a specialization sequence consisting of at least three courses.

In addition to the 45 hours of course credit, an acceptable thesis must be completed.

The program must be approved by the Chairman of the Command, Control and Communications Academic Group.



COURSE OFFERINGS

CC0001 SEMINAR (No Credit) (0-1).
Special lectures and discussion of matters related to C3.

CC0810 THESIS RESEARCH (0-0).
Every student conducting thesis research will enroll n this course.

CC3000 INTRODUCTION TO COMMAND, CONTROL AND COMMUNICATIONS (4-0).
Knowledge of current C3 systems and practice is ntroduced. A basic framework for understanding C3 s provided. Case studies are used as well as lessons earned from crises, field exercises and wargaming. PREREQUISITES: Enrollment in the Joint C3 curriculum, OS2103 (concurrently).

CC3001 MODELING COMMAND, CONTROL and COMMUNICATIONS SYSTEMS (4-0).
An understanding of C3 modeling in the context of combat models and modeling is provided. The fundamental concepts of combat processes are studied. Specific models of weapons and sensors are included. Examples of current applications and research trends are included. PREREQUISITES: CC3000 and OS2103.

CC3111 C3 MISSION AND ORGANIZATION (4-0).
A survey of command, control and communications organizations within OSD JCS, and the Service headquarters. Execution of National Security Nuclear Policy and planning for joint employment of general purpose forces are discussed. Service combat organization and service tactical C3 systems are covered. Emphasis is on description of existing C3 organizations and systems, with brief historical perspective. PREREQUISITE: SECRET clearance.

CC3900 SPECIAL TOPICS IN COMMAND, CONTROL AND COMMUNICATIONS (V-0).
Supervised study in selected areas of command, control and communications to meet the needs of individual students. May be repeated for credit if course conten changes. PREREQUISITE: Consen of Group Chairman. Graded on Pass/Fail basis only.

CC4001 C3 SYSTEMS ARCHITECTURE & ENGINEERING I (4-2).
Systems engineering concepts and processes. Structural analysis and design techniques. C3 structure and processes dynamics. C3 systems requirements determination. C3 architecture design. C3 architecture cost effectiveness evaluation. Design principles. Includes a C3 architecture design and evaluation project. PREREQUISITES: CC3001, OS3008, OS3604, TOP SECRET with eligibility for SI/SAO. U.S. Citizenship.

CC4002 C3 SYSTEMS ARCHITECTURE & ENGINEERING II (3-3).
Threat analysis. Hardware and software requirements determination. Functional analysis. Performance analysis. Cost modeling and estimation. Trade-off analysis. Error budget. Risk assessment. Includes a specific C3 systems design and evaluation project. PREREQUISITES: CC4001, TOP SECRET clearance with eligibility for SI/SAO. U.S. Citizenship.

CC4003 C3 SYSTEMS EVALUATION (2-4).
Experiments in determining C3 system effectiveness using war gaming and simulation. Design of experiments. Survey of current C3 systems evaluation techniques. PREREQUISITES: CC4002, 0S3603, TOP SECRET clearance with eligibility for SI/SAO. U.S. Citizenship.

CC4004 C3 IN NATO (4-0).
Application of C3 principles to the special problems of NATO. The range of alternatives to improving arms stability in Europe will be explored, including high-tech solutions such as FOFA, low-tech "green" barriers and militia, as well as arms negotiations. C3 planning and evaluation will be covered in application. PREREQUISITES: U.S. Citizenship and SECRET clearance; CC4003 or equivalent.

CC4005 SOVIET CONTROL OF FORCES AND MEANS (4-0).
The study of the Soviet equivalent of U.S. command, control and communications (C3). A context for studying Soviet control of forces and means is provided. Soviet military control concepts are emphasized. A consideration of Soviet communications and U.S. C3 countermeasures is included. The systems approach to integrating the different types of intelligence data to support U.S. decision making is employed. PREREQUISITES: U.S. Citizenship and TOP SECRET clearance with eligibility for SI/SAO; CC4003 or equivalent.

CC4006 ADVANCED C2 ANALYTICAL CONCEPTS (4-0).
The study of the combat organization's C2 in equilibrium and disequilibrium. The use of Petri Nets in understanding equilibrium is emphasized. The role of catastrophe and chaos theory in understanding disequilibrium is covered. PREREQUISITE: CC4003 or equivalent.

CC4007 STRATEGIC DEFENSE BATTLE MANAGEMENT, C3 AND DATA PROCESSING (4-0).
An advanced study of the application of C3 principles and design techniques to the Strategic Defense Initiative. Systems architectures for a strategic defense system, based on advancing technologies and existing military experience and doctrine, are defined and evaluated. An assessment of the Brilliant Pebbles concept is included. Issues such as software technology, threat definition, the role of human decision making, peacetime testing, communications and computer hardware technology insertion, communication networking, and the National Test Bed are examined. PREREQUISITES: U.S. Citizenship and SECRET clearance; CC4003 or equivalent.

CC4113 POLICIES AND PROBLEMS IN C3 (5-0).
Study of the fundamental role C3 systems fulfill in operational military situations, including crisis warning and crisis management. Analysis of the changing role of intermediate-level headquarters and its impact on C3 system requirements and design. Consideration of the complexities imposed on C3 systems as the force structure becomes more heterogeneous, as in the case of NATO. Case study of selected incidents and systems. Specifically for students in the C3 curriculum. PREREQUISITES: CC4003, TOP SECRET clearance with eligibility for SI/SAO. U.S. Citizenship.

CC4200 COMBAT SYSTEMS ENGINEERING (4-0).
This course examines the generation of combat system requirements and the relationships between operational, financial planning, and echnical communities in fielding a combat system that fulfills those requirements. The contribution of the technical disciplines to the statement and solution of decision problems in design, priority etting, and scheduling are explored through the use of currently outstanding issues. PREREQUISITES: Consent of the Instructor, basic probability and statistics, fourth quarter standing and SECRET clearance. Graded on a Pass/Fail basis only.

CC4900 ADVANCED STUDY IN COMMAND, CONTROL AND COMMUNICATIONS (V-0).
Supervised study in selected areas of command, control and ommunications to meet the needs of individual students. May be repeated for credit if course content changes. PREREQUISITE: Consent of Group Chairman. Graded on a Pass/Fail basis only.

DEPARTMENT OF COMPUTER SCIENC

Chairman:
Robert B. McGhee,
Professor,
Code CS, Spanagel Hall,
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Uno R. Kodres,
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Commander, U.S. Navy,
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Patrick D. Barnes, Captain, U.S. Air Force; Instructor (1989)*; MS, Air Force Institute of Technology, 1988.

Valdis Berzins, Associate Professor (1986); PhD, Massachusetts Institute of Technology, 1979.

Leigh W. Bradbury, Lieutenant Commander, U.S. Navy; Instructor (1988); MS, Corpus Christi State University, 1985.

Gregory D. Buzzard, Assistant Professor (1988); PhD, University of Michigan, 1988.

David A. Erickson, Adjunct Instructor (1988); MS, Stanford University, 1986.

Ahmed Gheith, Assistant Professor (1990); Georgia Institute of Technology, 1990.

Rachel Griffin, Lieutenant Commander, U.S. Navy; Instructor (1988); MS, Naval Postgraduate School, 1984.

Richard W. Hamming, Adjunct Professor (1976); PhD, University of Illinois, 1942.

David K. Hsiao, Professor (1982); PhD, University of Pennsylvania, 1968.

Gary Hughes, Commander, U.S. Navy; Instructor (1986); MS, Naval Postgraduate School, 1983.

Yutaka Kanayama, Professor (1990); PhD, Tokyo University, 1965.

Uno R. Kodres, Professor (1963); PhD, Iowa State University, 1958.

Yuh-jeng Lee, Assistant Professor (1987); PhD, University of Illinois at Urbana, 1987.

LuQi, Assistant Professor (1986); PhD, University of Minnesota, 1986.

Vincent Y. Lum, Professor (1985); PhD, University of Illinois at Urbana, 1966.

G.M. Lundy, Assistant Professor (1988); PhD, Georgia Institute of Technology, 1988.

Robert B. McGhee, Chairman and Professor (1986); PhD, University of Southern California, 1963.

Michael L. Nelson, Major, U.S. Air Force; Assistant Professor (1989); PhD, University of Central Florida, Orlando, 1988.

David R. Pratt, Adjunct Instructor (1990); MSCS, Naval Postgraduate School, 1988.

George A. Rahe, Professor Emeritus (1965); PhD, University of California at Los Angeles, 1965.

il C. Rowe, Associate Professor (1983); PhD, Stanford University, 83.

mothy J. Shimeall, Assistant Professor (1988); PhD, University of lifornia at Irvine, 1988.

n-Tak Shing, Associate Professor (1988); PhD, University of lifornia at San Diego, 1981.

uis D. Stevens, Adjunct Professor (1984); MS, University of lifornia at Berkeley, 1949.

rk Sturm, Major, U.S. Army; Visiting Adjunct Professor (1989); , University of Louisville, 1983.

wrence J. Williamson, Adjunct Professor (1989); PhD, University California at Berkeley, 1973.

Thomas Wu, Associate Professor (1985); PhD, University of lifornia at San Diego, 1983.

r M. Zaky, Assistant Professor (1989); PhD, Ohio State iversity, 1989.

chael J. Zyda, Associate Professor (1984); DSc, Washington iversity, 1984.

he year of joining the Naval Postgraduate School faculty is indicated in enthesis.

Department of Computer Science provides graduate training and cation in major areas of computer science. Thus, both basic and anced graduate courses are offered. Course work and research d to either the degree of Master of Science or Doctor of Philosophy. requirements to complete either program are rigorous and are parable to those of other major universities.

STER OF SCIENCE IN COMPUTER SCIENCE

degree Master of Science in Computer Science is awarded upon satisfactory completion of a program, approved by the Chairman, nputer Science Department, which satisfies, as a minimum, the owing degree requirements:

At least 40-quarter hours of graduate-level work of which at least 12-quarter hours must be at the 4000 level.

The Program shall include at least:
  28-quarter hours in Computer Science
  12-quarter hours in other disciplines

Completion of an approved sequence of courses constituting specialization in an area of Computer Science.

Completion of an acceptable thesis in addition to the 40-quarter hours of course work.

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

The Department of Computer Science has a program leading to the degree Doctor of Philosophy. Areas of special strength in the department are artificial intelligence/robotics, database systems, software engineering, computer graphics and computer architecture Minors in areas of other departments are possible. A noteworthy feature of these areas of research is that the candidate's research m be conducted off-campus in the candidate's sponsoring laboratory or unit of the Federal Government. The degree requirements are as outlined under the general school requirements for the doctor's degree.

COMPUTER SCIENCE LABORATORIES

Laboratory Overview

The departmental laboratories are designed to provide effective computing facilities to support instruction and research in the core areas of computer science. There are currently seven such laboratories: the Computer Science Academic Computing Laboratory the Artificial Intelligence Laboratory, the Database Systems Laboratory, the Graphics and Video Laboratory, the Microcomputer Systems Laboratory, the Software Engineering Laboratory and the Visual Database and Interface Laboratory. These laboratories are configured in a complex network system with remote file system access and resource sharing facilities. The network system consists a departmental backbone network interconnecting to the subnets of the individual laboratories which, in turn, are connected to lower level subnets of a client-server variety. In addition to providing loca connectivities, the backbone network also provides a gateway to distant networks such as Arpanet, Milnet, NFSnet and CSnet throughout the United States and across the continents.

Computer Science Academic Laboratory

The main pieces of equipment in the Computer Science Academic Laboratory are six Sun servers with over forty client workstations. Approximately half of the client workstations ar located within the laboratory for student access while the remaining client workstations are distributed to individual faculty and staff offices Each server is equipped with large memory and disk capacity with modem and terminal support for remote access. The laboratory provides a general purpose, time-sharing environment for a variety of database and programming languages such as Ingres, Prolog, Common Lisp, ADA, Pascal and C, as well as computer-aided softwar tools (CASE) and text processing packages.

Database Systems Laboratory

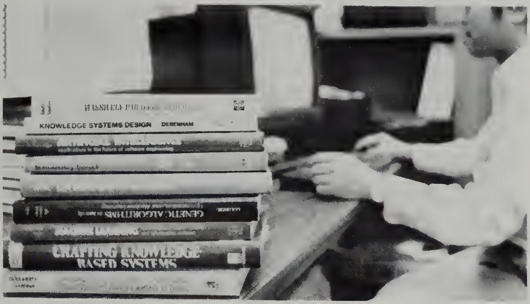
The current Database Systems Laboratory consists of nine Integrated Solutions, Inc. (ISI) workstations. Each ISI workstation contains a Motorola 68020 processor and 600+MB of disk storage. The workstations are connected via their own Ethernet network and through one of the workstations, to the departmental local area network.

raphics and Video Laboratory

he current Graphics and Video Laboratory consists of three Silicon raphics, Inc. IRIS graphics workstations. There is one IRIS 4D/ 0VGX four-processor workstation, one IRIS 4D/120GTX and one IS 4D/70GT. These workstations are used to provide research and struction in real-time, interactive graphics. The primary research e of the systems is in the production of inexpensive, three- mensional visual simulation systems and in the production of aphics workstation performance measurements. The IRIS 4D/ 0VGX workstation is based on the MIPS R-3000 processor. The X workstation is capable of filling 1,000,000 z-buffered, Gouraud- aded polygons per second. The laboratory is equipped with a real- me RGB to NTSC scan converter and VHS video capture equipment.

ftware Engineering Laboratory

e current Software Engineering boratory consists of one large Sun eserver and ten diskless node rkstations. The Sun workstations are ix-based, general purpose rkstations and are equipped with the A programming language and a riety of software engineering tools. e purpose of this laboratory is to ovide a state-of-the-art educational vironment for graphics-based software velopment automation. Current work the laboratory is on rapid ototyping, specification languages and computer-aided software stem design, software verification and testing.


KNOWLEDGE SYSTEMS DESIGN DEBENHAM
GENETIC ALGORITHMS
CRAFTING KNOWLEDGE BASED SYSTEMS

crocomputer Systems Laboratory

e current Microcomputer Systems Laboratory consists of 35 Zenith 48 microcomputers in support of research and instruction. The in use of the Z248 microcomputers is for instruction in beginning gramming with the Department of Defense's standard computer guage ADA. The Z248s are also used for research and instruction microprocessor programming, microprocessor architectures, working and distributed systems. The Z248s are networked to vide access to resources such as printers.

sual Database and Interface Laboratory

e current Visual Database and Interface Laboratory consists of cintosh II and IBM PC/AT compatible microcomputers. The main of the laboratory is research and instruction in human-computer erfaces for data retrieval systems. The main projects in the oratory are a hypertext system for the paperless ship project GOS) and a graphics language for databases project (GLAD).

tificial Intelligence Laboratory

Artificial Intelligence Laboratory consists of 8 Sun diskless kstations, 4 TI Explorer LISP machines and 4 Symbolics LISP chines. The Sun workstations are Unix-based, general purpose kstations. They are outfitted with LISP, Prolog and various wledge-based software tools. The Symbolics machines represent state of the art with respect to AI computing systems. One of the nbolics systems contains a Pixar Imaging Computer.

COURSE OFFERINGS

CS0001 COLLOQUIUM (NO CREDIT) (0-1).
Distinguished lecturer series. Attendance is required by students in their third through sixth quarters.

CS0100 REFRESHER FOR BEGINNING PROGRAMMING (NO CREDIT) (2-1).
Meets last 6 weeks of quarter. An introducti to computer algorithms, programs and hardware. Using structured programming an stepwise refinement techniques, students receive classroom instruction plus design an test programs in the laboratory. Computer projects of increasing difficulty are assigned. This course is not graded.

CS0101 REFRESHER FOR LABORATOR SYSTEMS (NO CREDIT) (2-1).
Meets last 6 weeks of quarter. Intended for computer science majors, to provide an introduction to computer science and computing laboratory facilities. Emphasis is on fundamental concepts of operating system, user interfaces, programming environments and program development tools. Topics inclu a survey of text processors, formatters and editors, compilers, linkers and other software tools, together with the basic principles and procedures for productive document/software development. Additiona topics include fundamentals of data structures and algorithms. This course is not graded.

CS0102 REVIEW FOR DIRECT INPUT STUDENTS (NO CREDIT) (2-1).
Meets entire quarter. An individualized course to cover the topics of CS0100 and CS0101. The course is open only to first quarter compute science majors who did not take CS0100 and CS0101. This course is not graded.

CS0810 THESIS RESEARCH (0-0)
Every student conducting thesis research will enroll in this course.

CS2450 COMPUTER PROGRAMMING WITH FORTRAN (3-1).
This course provides an overview of the computer system: hardware, software and the operating system. Algorithms and programs are developed using a structured approach and stepwise refinement. The design and testing of computer programs in FORTRAN are studied and practiced by the student in the laboratory. Computer projects of increasing difficulty are assigned. Graded on Pass/Fail basis only.

CS2920 INTRODUCTORY TOPICS IN COMPUTER SCIENCE (Hours vary 2-4 to 4-1) (V-V).
Designed to support introductory subject matter of special interest, dependent upon faculty availability. Topics will typically augment those offered in the basic core courses. This course may be lecture/lab oriented or self-paced, with prerequisites determined by the instructor. Students may repeat this course for credit with a different topic.

2970 STRUCTURED PROGRAMMING WITH ADA (4-1).
introduction to problem solving and structured programming with A, a high-level, block-structured programming language. This urse is for computer science majors and other students with a deep terest in the subject. Fundamental techniques of problem solving d using ADA to implement the solutions of non-numerical problems e presented. Several programming projects aimed at practicing these hniques are assigned during the course.

3010 COMPUTING DEVICES AND SYSTEMS (4-0).
imarily designed for non-computer science majors, this course exam- es the basic elements of computer systems through a hierarchy of e levels: the digital logic or device level, the microprogramming chine level, the conventional machine, the operating system ma- ine level and the assembly language machine level. Although empha- is on computer hardware, the logical equivalence of hardware and ftware is demonstrated by examples and trade-offs of both software d hardware implementation of basic functions. PREREQUISITE: A uctured programming course or consent of instructor.

3030 PRINCIPLES OF OPERATING SYSTEMS (4-0).
is course provides a broad overview of operating systems including mory management techniques, job scheduling, processor scheduling, vice management and data (information) management techniques. udies will also be included to illustrate the issues in manager- erating system interfaces, operating system selection, data control d security and operating systems utility support. Future trends in nputers will be discussed. PREREQUISITES: CS3010 or consent of structor.

3111 PRINCIPLES OF PROGRAMMING LANGUAGES (4-0).
introduction to the design, evaluation and implementation of ogramming languages. The four themes of name, data, control and ntactic structuring are traced through the five major programming nguage generations. Principles for the evaluation of languages are veloped and investigated. Key implementation concepts are covered, luding interpreters and runtime organization. PREREQUISITE: 2450 or CS2970, or consent of instructor.

3113 INTRODUCTION TO COMPILER WRITING (3-2).
exploration of the basics of modern compiler design and nstruction techniques. The fundamentals of scanning, parsing and npiler semantics are developed in the framework of modern npiler-compiler and translator-writing system technology. The oratory periods will be used to develop a small model compiler/ sembler. PREREQUISITES: CS3111 and CS3300 or consent of structor.

3200 INTRODUCTION TO COMPUTER CHITECTURE (3-2).
is course examines the organization of computers and processor hitectures from the digital logic level through assembly language. overview of hardware components including processors, memories d I/O is followed by an in-depth treatment of the following virtual chine levels: digital logic, microprogramming, machine language, erating system and assembly language. This is a “hands on” course luding laboratory projects in each virtual machine level. EREQUISITES: CS2970 and either EC2810 or equivalent.

CS3300 DATA STRUCTURES (3-1).
The course deals with the specification, implementation and analysis of data structures. Common data objects such as strings, arrays, records, linear lists and trees, together with the operations used to manipulate these objects are studied. Particular emphasis is placed on linked structures. Implementation of symbol tables by hash tables and other means is presented. Applications to memory management, compiler design and sorting/searching algorithms are given. Computer projects in a high-level language are required. PREREQUISITE: CS2970 or consent of instructor.

CS3310 ARTIFICIAL INTELLIGENCE (4-0).
Survey of topics and methods of Artificial Intelligence. Methods include rule-based systems, heuristic search and exploitation of natural constraints, means-ends analysis, semantic networks and frames. Emphasis is placed on solving problems that seem to require intelligence rather than attempting to simulate or study natural intelligence. Projects to illustrate basic concepts are assigned. PREREQUISITE: MA0125 or MA2025 or consent of instructor.

CS3320 DATABASE SYSTEMS (3-1).
An up-to-date introduction to database systems including database system architectures, physical storage organization, data models, data languages and design of databases. PREREQUISITE: CS3300 or consent of instructor.

CS3450 SOFTWARE SYSTEM DESIGN (3-1).
This course covers the design and implementation of system software elements, including assemblers, loaders, input/output control subsystems and interpreters. PREREQUISITES: CS3200, CS3300 and CS3111 or consent of instructor.

CS3460 SOFTWARE METHODOLOGY (3-1).
Introduction to the software life cycle. Methods for requirements definition, design and testing of software. Basic concepts of software engineering, including stepwise refinement, decomposition, information hiding, debugging and testing. PREREQUISITES: CS3111 and CS3300.

CS3502 COMPUTER COMMUNICATIONS AND NETWORKS (4-0).
An introduction to the structure and architecture of computer networks. The physical, data link and network layers of the ISO model are covered, as well as some aspects of the higher layers. Several important communication protocols are studied, including the currently used models for their specifications and analysis. Local Area Networks, such as Ethernet and Token Ring, are also covered. Term papers and/or projects are an important aspect of this course. PREREQUISITE: CS3200 or CS3010.

CS3550 COMPUTERS IN COMBAT SYSTEMS (3-2).
This course describes the functions and the algorithms of combat systems human interaction and systems organization in terms of processes. The laboratory component of the course allows student hands-on experience with the algorithms and input/output devices. Included are navigational tracking and ballistic functions, display control and the use of wakeup and block primitives in process control. PREREQUISITES: CS2970 and CS3200 or equivalent.

S3601 THEORY OF FORMAL LANGUAGES AND UTOMATA (4-0).

ıe material of this course will cover the Chomsky hierarchy of ırmal Languages (regular sets, context-free languages, context-nsitive languages and recursively enumerable languages) and the pes of grammars and automata associated with each class in the erarchy. Emphasis is placed on the major results of the theory as ey relate to language and compiler design. In addition, the major sults involving the concept of undecidability are covered. REREQUISITES: MA2025 and MA3026 or equivalent.

33650 DESIGN AND ANALYSIS OF ALGORITHMS (4-0).

focus on the design and analysis of efficient algorithms. Techniques analyzing algorithms in order to measure their efficiency are esented. Control structure abstractions, such as divide and conquer, eedy, dynamic programming, backtrack (branch and bound) and al search methods are studied. The theory of NP-completeness is esented along with current approaches to NP-hard problems. REREQUISITES: CS3300, MA2025 and MA3026 or equivalent.

33800 DIRECTED STUDY IN COMPUTER SCIENCES ariable hours 0-2 to 0-8). (0-V).

dividual research and study by the student under the supervision of nember of the faculty. The course is intended primarily to permit erested students to pursue in depth subjects not fully covered in mal class work. PREREQUISITE: Consent of instructor. Graded on ss/Fail basis only.

33920 TOPICS IN COMPUTER SCIENCE ariable hours 2-4 to 4-1) (V-V).

signed to support subject matter of special interest, dependent on faculty availability. Topics will either be drawn from areas not vered by core courses, or be focused treatments of subjects of nited scope. This course may be lecture or lab oriented, with erequisites determined by the instructor. Students may repeat this ırse for credit with a different topic. PREREQUISITE: Consent of tructor.

4112 OPERATING SYSTEMS (4-0).

in-depth theoretical treatment of operating systems concepts. ıjor course topics include process synchronization using naphores, critical regions and rendezvous, virtual memory luding demand paging and segmentation, dynamic linking and ding, file structures and information security. The producer-ısumer problem, readers and writers problem and the dining losophers problem are examined. Architectural and language plications of evolving operating systems are considered. EREQUISITE: CS3450 or consent of the instructor.

4113 ADVANCED LANGUAGE TOPICS (4-0).

ıs course covers advanced topics and recent developments in gramming languages and compilers. Typical topics are functional gramming, object-oriented programming and logic programming. th theory and practice are covered. PREREQUISITE: CS3111 or ısent of the instructor.

CS4114 ADVANCED TOPICS IN OBJECT-ORIENTED PROGRAMMING (3-2).

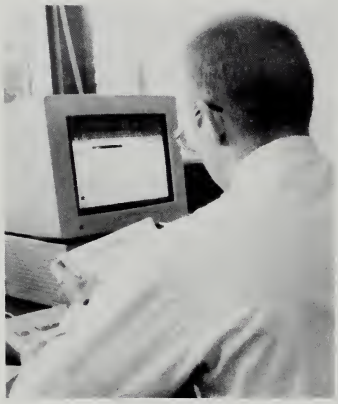
This course covers the area of object-oriented programming (OOP) in detail. Investigating current OOP research will be the mainstay of the class. Typical topics will include data abstracation, inheritance, encapsulation, delegation, object-oriented databases and concurrency. Object-oriented languages and applications will also be discussed. A significant programming project is also required.

CS4150 PROGRAMMING TOOLS AND ENVIRONMENTS (4-0).

The design and implementation of tools to aid software development are the topics of this course, including syntax-directed editors, version-control systems, language-oriented debuggers, symbolic execution vehicles, programming databases, macroprocessors and automatic programming tools. These topics are discussed in the context of an integrated, language-oriented programming environment. PREREQUISITES: CS 3450 and CS 4113 or consent of the instructor.

CS4202 COMPUTER GRAPHICS (3-2).

An introduction to the principles of the hardware and the software used in the production of computer generated images. The focus of the course is a major design project utilizing the departmental computer graphics and image processing facilities. The course is intended for students proficient in the development of software systems. PREREQUISITE: CS2970, CS3200, CS3300 or consent of the instructor.



CS4203 INTERACTIVE COMPUTATION SYSTEMS (3-2).

This course studies the principles of human computer interfaces and their implementation techniques. Several different interfaces are covered with an emphasis on the direct manipulation interface. The principles discussed in the course will be illustrated with several commercial software systems. The main focus of the course is a design project of building a simple application software system that supports human-computer interface principles. PREREQUISITES: CS3111 and CS3300 or consent of instructor.

CS4310 ADVANCED ARTIFICIAL INTELLIGENCE (4-0).

Artificial Intelligence has seen a rapid growth in applications in recent years. This course will survey key areas of current research. Areas surveyed include language understanding, computer vision, planning human tutoring, qualitative reasoning and automated reasoning. PREREQUISITE: CS3310 or consent of instructor.

CS4311 EXPERT SYSTEMS (3-1).

This course covers fundamental issues in expert system design and construction. Topics include: knowledge representation schemes and reasoning methods, uncertainty management, truth maintenance trade-off of search versus knowledge by computer induction, real-time knowledge-based systems, system building tools and shells and validation and measurements methods. Several projects related to these topics will be assigned throughout the course. PREREQUISITE: CS3310.

S4312 ADVANCED DATABASE YSTEMS (3-1).
equel to CS3320, Database Systems. The ourse will provide an in-depth coverage of elational database theory, distributed latabase systems, semantic data models, uery processing and optimization, logic nd databases and other advanced topics. Many topics will be illustrated using both ommercial and prototype database ystems. PREREQUISITE: CS3320 or onsent of instructor.

S4313 ADVANCED ROBOTIC YSTEMS (4-0).
his course is concerned with the inematics, dynamics and control of robotic ystems. These systems will be studied rimarily by means of computer simulations sing graphics work stations. In addition to asic principles, the course will consider specific examples including nstances of mobile robots as well as fixed-base (industrial) robots. obot intelligence and task planning will be emphasized rather than wer-level implementation details. PREREQUISITE:CS3310 or onsent of instructor. In addition, a basic understanding of calculus nd matrix algebra is essential to this course.

S4314 COMPUTERS FOR ARTIFICIAL INTELLIGENCE (4-0).
ubject matter of this course is concerned with computer systems esigned to achieve high efficiency with respect to artificial itelligence applications. The course will be conducted in a seminar rmat, with the specific systems studied in any given quarter being etermined by the student and faculty interests. Examples of the pes of computers to be considered include: Lisp machines, Prolog achines, image processors, vision computers. etc. In general, an fort will be made to investigate the organization and performance of mplete systems including hardware and software aspects. REREQUISITE: CS3310 or consent of instructor.

S4322 ADVANCED DATABASE SYSTEMS SEMINAR (3-1).
his course covers the advanced and current research on database pics that have not been discussed fully in the prior database courses S3320 and CS4312. Possible topics to be discussed in the course clude database machines (especially multi-lingual and multi-ackend systems), multimedia DBMS, semantic modeling, DB curity, knowledge-based DBMS, non-normalized relations, temporal formation handling, advanced data structures, real-time database stems, etc. The studies may be theoretical, pragmatic and alytical, or experimental using some advanced prototype database stems. PREREQUISITE: CS4300 or CS4312, or consent of structor.

S4450 ADVANCED COMPUTER ARCHITECTURE (4-0).
lvanced topics in computer architecture and the application of ncepts in computer architecture to the design and use of computers. e topics discussed include classes of computer architecture, plication-oriented architecture and high-performance architecture. REREQUISITE: CS3200 or equivalent.

CS4451 DESIGN AND ANALYSIS OF MULTIPLE-PROCESSOR, REAL-TIME COMPUTERS (3-1).

This course covers computer architectures ranging from single instruction stream to multiple data stream architectures. Processing capacities of vector processors, array processors, multiprocessors and massively parallel processors are compared to each other in various real time applications. Parallel processing software issues ranging from parallel processing languages to operating systems support issues are considered. Reliability, availability and survivability of systems are also considered. PREREQUISITES: CS3200 and CS3450 or consent of instructor.

CS4470 ADVANCED COMPUTER GRAPHICS TOPICS (3-2).

Advanced topics in computer image generation. The topics discussed include quality and realism in computer images, advanced realtime interactive systems and special architectures for the real-time generation and display of computer images. PREREQUISITES: CS4202 and consent of instructor.

CS4500 SOFTWARE ENGINEERING (3-1).

The techniques for the specification, design, testing, maintenance and management of large software systems. Specific topics include software life cycle planning, cost estimation, requirements definition and specification, design, testing and verification, maintenance and reusability. The laboratory sessions will discuss special topics. PREREQUISITE: CS3460 or consent of instructor.

CS4520 ADVANCED SOFTWARE ENGINEERING (3-0).

Sequel to CS4500. The methods for specifying, designing and verifying software systems are covered in depth, with emphasis on automatable techniques and their mathematical basis. The techniques are applied to construct and check ADA programs using a formal specification language. The course concludes with a summary of current research areas in software engineering. PREREQUISITE: CS4500 or consent of instructor.

CS4530 SOFTWARE ENGINEERING IN ADA (3-0).

Sequel to CS4500. The study of software engineering in ADA represents a tremendous opportunity for improvement in the clarity, reliability, efficiency and maintainability of software systems. Special features of designing large, real-time, embedded computer systems, automated tools in the ADA environment and many applications of the principles in software engineering will be illustrated through the systematic study of the ADA language. PREREQUISITE: CS4500 or consent of the instructor.

CS4550 DISTRIBUTED COMPUTING (4-0).

The course covers computer systems that have multiple computers connected by communications links. The primary emphasis is on the interconnection of local area networks to form wide area internetworks. The key aspects of these systems include performance, reliability, routing, protocol demultiplexing, the client-server paradigm and name resolution. PREREQUISITES: CS3450 and CS3502 (CS4112 will be helpful as a prerequisite, or corequisite).

S4601 COMPUTER SECURITY (4-0).

his course is concerned with fundamental principles of computer
ecurity. It covers privacy concerns, secrecy issues, operational
ecurity, physical security, hardware security, software security,
ommunications security and data security. There is a special
mphasis on multilevel security and access control in computer
ystems. PREREQUISITES: For CS majors, CS3200, CS3450, CS3460,
S3320 and CS3502; for CSM majors, CS3010, CS3020, CS3030 and
S3502.

S4800 DIRECTED STUDY IN ADVANCED COMPUTER CIENCE (Variable hours 0-2 to 0-8) (0-V).

irected advanced study in computer science on a subject of mutual
terest to student and faculty member. Intended primarily to permit
udents to pursue in-depth subjects not fully covered in formal class
ork or thesis research. May be repeated
r credit with a different topic.
REREQUISITE: Consent of instructor.
raded on Pass/Fail basis only.

S4900 RESEARCH SEMINAR IN OMPUTER SCIENCE (0-2).

n examination of the current and planned
search of Computer Science faculty and
h. D. students in multiple fields of study.
he course is designed to support Computer
ience students in their fourth quarter of
udy in the selection of an area/topic for
esis research. PREREQUISITE: Computer
ience students in fourth quarter or
nsent of department Chairman. Graded on
ss/Fail basis only.

S4901 RESEARCH SEMINAR IN OMPUTER SCIENCE II (2-0).

is course develops skills in software
scription necessary for successful
mpletion of a MS thesis. Students who
n already demonstrate excellent writing
ills will be able to validate this course. PREREQUISITE: CS4900 or
nsent of instructor.

4910 ADVANCED READINGS IN COMPUTER SCIENCE ariable hours 0-2 to 0-8) (0-V).

rected readings in computer science on a subject of mutual interest
student and faculty member. The course allows in-depth study of
vanced topics not fully covered in formal class work or thesis
search. May be repeated for credit with a different topic.
EREQUISITE: Consent of instructor.

4920 ADVANCED TOPICS IN COMPUTER SCIENCE ariable hours 2-4 to 4-1) (V-V).

signed to support advanced subject matter of special interest,
pendent upon faculty availability. Topics will be drawn from areas
t covered by other advanced courses, or be focused treatments of
bjects of limited scope. This course may be lecture or lab oriented,
th prerequisites determined by the instructor. Students may repeat
is course for credit with a different topic.

DEPARTMENT OF ELECTRICAL AN COMPUTER ENGINEERIN

Chairman:
Michael A. Morgan,
Professor,
Code EC, Spanagel Hall,
Room 437,
(408) 646-2081,
AV 878-2081.

Associate Chairmen:

Instruction
Robert D. Strum,
Professor,
Code EC/St, Spanagel Hall,
Room 433B,
(408) 646-3451,
AV 878-3451.

Student Programs
John P. Powers,
Professor,
Code EC/Po, Bullard Hall,
Room 223,
(408) 646-2679,
AV 878-2679.

Richard W. Adler, Adjunct Professor (1970)*; PhD, Pennsylvania State University, 1970.

Mohammed Belkhayat, Instructor (1990); MS, University of South Carolina, 1989.

Raymond Bernstein, Adjunct Instructor (1989); MS, Naval Postgraduate School, 1982.

Jeffrey B. Burl, Assistant Professor (1987); PhD, University of California at Irvine, 1987.

Jon T. Butler, Professor (1987); PhD, Ohio State University, 1973.

Mitchell L. Cotton, Associate Professor (1954); EE, University of California at Berkeley, 1954.

Roberto Cristi, Associate Professor (1985); PhD, University of Massachusetts, 1983.

Laura Ehret, Adjunct Research Instructor (1989); MS, Florida State University, 1986.

Gerald D. Ewing, Associate Professor (1963); PhD, Oregon State University, 1964.

Monique P. Farques, Assistant Professor (1989); PhD, Virginia Polytechnic Institute and State University, 1988.

Douglas J. Fouts, Assistant Professor (1990); PhD, University of California at Santa Barbara, 1990.

Tri T. Ha, Professor (1987); PhD, University of Maryland, 1977.

Scott H. Hershey, Lieutenant Commander, U.S. Navy; Instructor (1988); MS, Naval Postgraduate School, 1984.

Ralph Hippenstiel, Associate Professor (1986); PhD, New Mexico State University, 1985.

Ramakrishna Janaswamy, Assistant Professor (1987); PhD, University of Massachusetts, 1986.

Stephen Jauregui, Jr., Adjunct Professor (1971); PhD, Naval Postgraduate School, 1962.

David C. Jenn, Associate Professor (1990); PhD, University of Southern California, 1989.

Jeffrey B. Knorr, Professor (1970); PhD, Cornell University, 1970.

Allan Kraus, Adjunct Professor (1976); PhD, University of South Florida, 1976.

Alex W. Lam, Assistant Professor (1990); PhD, University of Illinois, 1987.

Chin-Hwa Lee, Associate Professor (1982); PhD, University of California at Santa Barbara, 1975.

Hung-Mou Lee, Associate Professor (1982); PhD, Harvard University, 1981.

Frederic H. Levien, Adjunct Teaching Professor (1990); MS, Lehigh University, 1967.

Herschel H. Loomis, Jr., Professor (1981); PhD, Massachusetts nstitute of Technology, 1963.

Sherif Michael, Associate Professor (1983); PhD, University of West Virginia, 1983.

James H. Miller, Associate Professor (1987); ScD, Massachusetts nstitute of Technology and Woods Hole Oceanographic Institution, 987.

Paul H. Moose, Associate Professor (1980); PhD, University of Washington, 1970.

Michael A. Morgan, Professor (1979); PhD, University of California t Berkeley, 1976.

Glen A. Myers, Associate Professor (1965); PhD, Stanford University, 1965.

Rudolph Panholzer, Professor (1964); DSc, Technische Hochschule n Graz, Austria, 1961.

Ron J. Pieper, Associate Professor (1990); PhD, University of Iowa, 984.

ames R. Powell, Commander, U.S. Navy; Instructor (1989); MS, Naval Postgraduate School, 1984.

ohn P. Powers, Professor (1970); PhD, University of California at anta Barbara, 1970.

R. Clark Robertson, Associate Professor (1989); PhD, University of exas at Austin, 1983.

. Homer Rood, Lieutenant Commander, U.S. Navy; Instructor 1990); MS, Naval Postgraduate School, 1982.

homas A. Schwendtner, Captain, U.S. Air Force; Instructor 1989); MS, University of Colorado, 1989.

hridhar, B. Shukla, Assistant Professor (1990); PhD, North arolina State University, 1989.

obert D. Strum, Professor (1958); MS, University of Santa Clara, 964.

rederick Terman, Adjunct Professor (1983); MSEE, Stanford niversity, 1964.

George J. Thaler, Professor Emeritus (1951); DEng, Johns Hopkin University, 1947.

Charles W. Therrien, Professor (1984); PhD, Massachusetts Institute of Technology, 1969.

Harold A. Titus, Professor (1962); PhD, Stanford University, 1962.

Murali Tummala, Associate Professor (1987); PhD, India Institute Technology, 1984.

Donald van Z. Wadsworth, Adjunct Professor (1988); PhD, Massachusetts Institute of Technology, 1958.

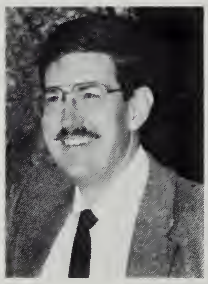
Stephen M. Williams, Assistant Professor (1990); PhD, University Missouri-Columbia, 1989.

Chyan Yang, Assistant Professor (1987); PhD, University of Washington, 1987.

Lawrence J. Ziomek, Associate Professor (1982); PhD, Pennsylvani State University, 1981.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

The Department of Electrical and Computer Engineering is the major contributor to programs for the education of officers in the Electronic Systems Engineering curriculum, the Communications Engineering curriculum and the Space Systems Engineering curriculum. Additionally, the department offers courses in support of other curricula such as Electronic Warfare Systems Technology, Telecommunications Systems Management, Command, Control and



After graduating from the Naval Postgraduate School in 1986 with both a Master of Science degree and Engineers degree in Electrical Engineering, **Lieutenant Commander Kevin J. Delaney** returned to NPS in 1989 to pursue his Ph.D. in Electrical Engineering.

Delaney's dissertation, entitled "Time-Domain Classification of Acoustic Transients" explores better ways to process sonar signals. Delaney plans to use what he learns at NPS in his next job as an Engineering Duty Officer, where he'll be involved in research, development, acquisition, installation and testing of submarine combat systems.

"For me, having the opportunity to work on submarine-related research programs is important and NPS is allowing me to get the experience that I can draw on in the future," says Delaney.

Delaney lives in Carmel Valley with his wife, Suzan. A native of the Monterey area, Suzan works as a writer/editor of education materials for a local school district. They met during his first tour at NPS, so coming back for his second tour was like "coming home" for the two.

ommunications, Space Systems Operations, Weapons Systems ngineering, Underwater Acoustics and Engineering Acoustics.

he department offers programs leading to the Master of Science egree in Electrical Engineering (MSEE), the degree of Electrical ngineer (EE) and Doctor of Philosophy (Ph.D.). The department ypically graduates 80-90 MSEE degree candidates, five EE degree ecipients and one Ph.D. per year.

typical MSEE student will spend six to twelve months learning or eviewing material at a junior or senior level before entering into raduate studies. The graduate study portion of a typical program is bout one year in duration with a combination of course study and hesis work being performed. The thesis portion of the study is the quivalent of four courses with an acceptable written thesis being a equirement for graduation.

he curriculum is organized to provide the students with coursework panning the breadth of Electrical and Computer Engineering. tudents are required to take at least one graduate-level course in andom processes, applications of random processes and mathematics. addition to these requirements, students concentrate in one major rea of Electrical and Computer Engineering by taking a planned quence of advanced courses. Currently there are formal ncentrations in:

ommunications Systems
omputer Systems
uidance, Navigation and Control Systems
lectromagnetic Systems
ignal Processing Systems

he program leading to the MSEE is accredited as an Electrical ngineering Program at the advanced level by the Engineering ccreditation Commission of the Accreditation Board for Engineering d Technology.

he department has about fifty faculty members either on a rmanent or visiting basis contributing to the instructional and search programs.

ASTER OF SCIENCE IN ELECTRICAL ENGINEERING

Bachelor of Science in Electrical Engineering or its equivalent is quired. Credits earned at the Naval Postgraduate School and edits from the validation of appropriate courses at other stitutions are combined to achieve the degree equivalence.

complete the course requirements for the master's degree, a udent needs a minimum of 36 credits in the course sequence 3000 - 99 of which at least 27 credits must be in Electrical and Computer ngineering. Specific courses may be required by the department and least four courses that total a minimum of 12 credits, must be in e course sequence 4000 - 4999.

acceptable thesis must be presented and approved by the partment.

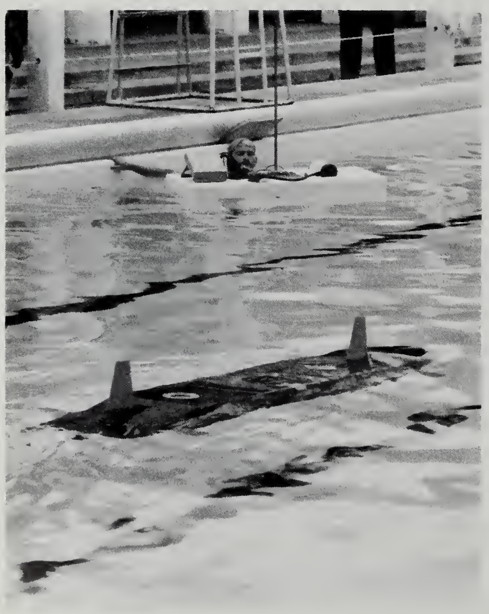
MASTER OF SCIENCE IN ENGINEERING SCIENCE

Students with acceptable academic backgrounds may enter a program leading to the degree Master of Science in Engineering Science. The program of each student seeking this degree is to include at least 36-credit hours in the course sequence 3000 - 4000 in the disciplines of Engineering, Science and Mathematics. At least 12 of these 36 hours must be at the 4000 level and at least 20 hours are to be in Electrical Engineering courses. A minimum of 8-quarter hours in 4000-level Electrical Engineering courses and at least 12-credit hours in courses outside of the Electrical and Computer Engineering Department are required. All students must submit an acceptable thesis. This program provides depth and diversity through specially arranged course sequences to meet the needs of the Navy and the interests of the individual. The department Chairman's approval is required for all programs leading to this degree.

ELECTRICAL ENGINEER

Students with strong academic backgrounds may enter a program leading to the degree Electrical Engineer.

A minimum of 72 graduate-course credits is required for the award of the engineer's degree of which at least 54 credits must be in Electrical and Computer Engineering.



Of these at least 36 hours are to be in courses in the sequence 4000 - 4999. An acceptable thesis must be completed. Approval of all programs must be obtained from the Chairman, Department of Electrical and Computer Engineering.

DOCTOR OF PHILOSOPHY

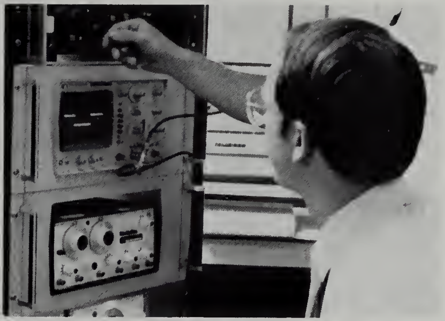
The Department of Electrical and Computer Engineering has an active program leading to the degree Doctor of Philosophy. Joint programs with other departments are possible. A noteworthy feature of these programs is that the student's research may be conducted away from the Naval Postgraduate School in a cooperating laboratory or other installation of the Federal Government. The degree requirements are as outlined under the general school requirements for the doctor's degree.

LABORATORIES

The laboratories of the department serve the dual role of supporting the instructional and research activities of the department. The department has well-developed laboratories in each area of specialty.

The Controls Laboratory is primarily an instructional laboratory, supporting experiments in simulation and in hardware manipulation. The Circuits/Electronics Laboratory is also an instructional laboratory supporting courses in circuit analysis and design as well as electronic devices and applications.

The Digital Systems Laboratory supports both instruction and research. The laboratory is equipped with microprocessor development systems including an HP64000 for advanced course work and thesis research. CAD facilities are capable of schematic capture, circuit simulation and fault detection. Major systems in the Computer Laboratory include a VAX 11/758 and a number of intelligent workstations with interactive color graphics and image processing systems. A department-wide Ethernet system will provide resource-sharing and will integrate these systems with office and laboratory microcomputers.



The VLSI Laboratory supports work in system design using integrated circuits and design of custom integrated circuits. Color graphic displays are used for layout of N-channel MOS (Metal-Oxide-Semiconductor) (NMOS) and Complementary MOS (CMOS) circuits.

The Optical Electronics Laboratory supports both research and courses in the areas of optics that use electronics. The laboratory has low and medium power lasers including CO lasers, an argon ion laser, a dye laser, a Nd:YAG laser and a variety of HeNe and diode lasers. A variety of detectors and imaging equipment is also available.

The Radar and EW Laboratories support courses and thesis work. Working radar systems and EW systems have been modified to allow student access to the signal processing portions of the equipment.

The purpose of the Space Systems Laboratory is to provide the instrumentation, computer software and systems necessary to support instructional activities and research related to spacecraft and space systems. This is a relatively new laboratory which currently has a DOMSAT earth terminal and a TRANSIT navigation satellite receiver installed.

The Microwave Laboratory provides materials, devices, components, instrumentation, computer software and systems support instructional activities and research in the frequency range from 100 MHz to 300 GHz.

The Transient Electromagnetics Laboratory supports research related to radar target classification based on broad band, high-resolution coherent backscattering.

Other support facilities within the department include the Production Laboratory for the prototyping, layout and production of printed circuit boards, the Calibration and Instrument Repair Laboratory, as well as the Supply and Issue Facility for the ordering of instrumentation and electronic components.

COURSE OFFERINGS

EC0810 THESIS RESEARCH (0-0).

Every student conducting thesis research will enroll in this course.

EC0950 SEMINAR (NO CREDIT) (0-1).

Lectures on subjects of current interest will be presented by invited guests from other universities, government laboratories and from industry, as well as by faculty members of the Naval Postgraduate School.

EC2100 CIRCUIT ANALYSIS I (3-2).

An introductory course for students with little or no electrical engineering background. The fundamental concepts of voltage, current, power, signals and sources are developed and applied to the analysis of purely resistive circuits, as well as capacitive and inductive circuits. The principle of superposition, the one-port equivalents due to Thevenin and Norton and the source transformation theorem are introduced. The natural and step responses of simple R-C and R-L circuits are studied. PREREQUISITES: Linear algebra and calculus (may be concurrent).

EC2110 CIRCUIT ANALYSIS II (3-2).

Dynamic circuits are analyzed in the sinusodial steady state using phasor methods. Frequency response, filtering and ac power are discussed. The Laplace transform and its application to circuit analysis are presented. Network functions and other s-domain concepts are developed. Operational amplifier applications are introduced. PREREQUISITE: EC2100.

EC2150 REVIEW OF CIRCUIT ANALYSIS (4-2).

A review of circuit analysis for students with a moderate background in electrical engineering. Starting from a review of the basic concepts of current, voltage, power, signals and sources, the methods of dynamic circuit analysis are developed through the real and complex frequency domains. Network functions, frequency response and ac power are included, as are the more common circuit theorems. PREREQUISITE: Some background in circuit analysis.

EC2170 INTRODUCTION TO ELECTRICAL ENGINEERING (4-2).

An introductory course intended for students not majoring in electrical engineering. Circuit elements, signals and waveforms; power and energy; Kirchhoff's laws and resistive circuits; diode circuit applications; application of Laplace transform to the step and sinusoidal response of dynamic networks. PREREQUISITES: Linear algebra and calculus (may be concurrent).

EC2200 ELECTRONICS ENGINEERING I (3-3).

An introduction to electronic devices and circuits. Electronic properties and charge-flow mechanisms of crystalline semiconductor material; properties of p-n junctions in diodes and bipolar junction transistors; static and dynamic models for these devices; applications of diodes and the design of wave shaping circuits and power supplies; application of transistors in the design of amplifiers and digital systems; characteristics, fabrication and the design of integrated circuits. PREREQUISITE: A first course in electrical engineering.

EC2210 ELECTRONICS ENGINEERING II (3-2).
Characteristics of Field Effect Transistors (FET) including MOS and CMOS transistors and their theory of operation. Application of FET in the design of discrete amplifiers and biasing considerations. Frequency response considerations for the design of discrete device amplifiers. Application and design of feed-back amplifiers and operational amplifiers. PREREQUISITE: EC2200.

EC2220 DESIGN OF ELECTRONIC CIRCUITS (2-4).
A project course covering the design and applications of analog and digital integrated circuits (ICs). Includes an introductory overview of important communications ICs and practical experimental design, construction and testing of circuits and systems using these devices. PREREQUISITES: EC2210 and EC2500.

EC2250 ACCELERATED REVIEW OF ELECTRONICS ENGINEERING (4-2).
An advanced review of semiconductor devices and circuits intended for students who have previously studied the subject matter of EC2200 and EC2210. PREREQUISITE: Sufficient background in electronic circuits. Graded on Pass/Fail basis only.

EC2300 CONTROL SYSTEMS (3-2).
The application of feedback principles to the design of linear control systems using frequency domain (Bode-Nichols), s-domain (root locus) and state variable methods. Performance criteria including steady-state accuracy, transient response specifications, bandwidth and integral performance indices are presented. Laboratory work includes testing and evaluation of physical systems and design studies. PREREQUISITE: EC2420.

EC2400 DISCRETE SYSTEMS (3-0).
Principles of discrete systems, including modeling, analysis and design. Topics include difference equations, convolution, stability, z-transforms, system diagrams and realizations, state equations and frequency response. Simple digital filters are designed and evaluated. PREREQUISITE: FORTRAN or other high-level language.

EC2410 FOURIER ANALYSIS OF SIGNALS AND SYSTEMS (3-0).
Analysis of analog signals in the time and frequency domains; properties and applications of Fourier series and transforms; convolution and correlation. Introduction to modulation and sampling of analog signals. PREREQUISITES: Differential equations and EC2110 (or equivalent).

EC2420 LINEAR SYSTEMS (3-0).
Formulation of system models including state equations, transfer functions and system diagrams for continuous and sampled-data systems. Computer and analytical solution of system equations. Stability, controllability and observability are defined. Introduction to design by pole placement using state feedback. PREREQUISITES: Laplace transform, differential equations, linear algebra and FORTRAN or other high-level language.

EC2450 ACCELERATED REVIEW OF LINEAR SYSTEMS (4-2).
An advanced review of continuous and discrete system theory intended for students who have previous education in these areas. Topics covered by each student will depend upon background and competence in the subject matter of EC2400, EC2410 and EC2420. Some parts of the course will be in the self study mode. PREREQUISITE: Sufficient background in linear systems theory. Graded on Pass/Fail basis only.

EC2500 COMMUNICATIONS THEORY (3-2).
In this first course on the electrical transmission of signals, the following concepts are formulated mathematically and then considered in terms of devices and systems: sampling; pulse amplitude, position and width modulation; amplitude, phase and frequency modulation and demodulation with analog and digital messages; time and frequency multiplexing. PREREQUISITE: EC2410.

EC2600 INTRODUCTION TO FIELDS AND WAVES (4-0).
Static field theory is developed from physical and mathematical principles. Time-varying Maxwell equations are introduced and solutions to the wave equations are presented. Additional topics include boundary value problem solutions, plane wave propagation in vacuum and materials. PREREQUISITE: Vector calculus.

EC2610 ELECTROMAGNETIC ENGINEERING (3-1).
A continuation of EC2600. Topics include the analysis and design of transmission lines, waveguides, resonators and high frequency components. Applications are presented in the laboratory. PREREQUISITE: EC2600.

EC2650 ACCELERATED REVIEW OF ELECTROMAGNETICS (4-2).
A comprehensive review of basic electromagnetic theory intended for students who have previously studied the subject matter of EC2600 and EC2610. PREREQUISITE: Sufficient background in electromagnetic theory. Graded on Pass/Fail basis only.

EC2800 INTRODUCTION TO MICROPROCESSORS (3-2).
An introduction to the organization and operation of microprocessors and microcomputers. Topics include: the instruction set, addressing methods, data types and number systems, stack and register organization, exception processing, assembly language programming techniques including macros, assembly language implementation of typical control structures, data structures and subroutine linkage methods. Laboratory sessions teach a systematic method for program design and implementation. The laboratory assignments consist of a series of programs which collectively implement a major software project. PREREQUISITES: A high level language and EC2820 (may be concurrent).

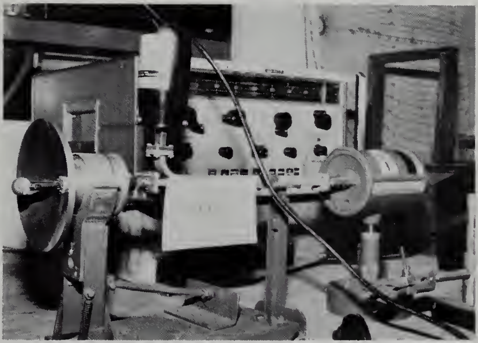
EC2810 DIGITAL MACHINES (3-2).
An introductory course in the analysis of digital systems and computers. No previous background in electrical engineering or digital techniques is assumed. Topics include: Number systems, logic gates and logic design; arithmetic circuits; flip-flops, counters, registers and memories; basic digital computer architecture and the internal operation of computers; and elementary machine-language programming. The laboratories are devoted to the study of logic elements, arithmetic circuits, flip-flops, registers and counters.

EC2820 DIGITAL LOGIC CIRCUITS (3-2).
An introductory course in the analysis and design of digital circuits. No previous background in digital concepts or electrical engineering is assumed. Topics include: Boolean algebra, truth tables, logic gates, integrated circuit families, decoders, multiplexers, arithmetic circuits, PLA's, ROM's, design of combinational circuits using SSI and MSI components, sequential logic including latches, flip-flops, registers, counters and memories, analysis and design of synchronous circuits using state tables and state diagrams. The laboratories are devoted to the study of combination and sequential circuits and include a sequence of design projects involving increasingly complex digital functions.

EC2890 DIGITAL CIRCUIT DESIGN LABORATORY (0-6).
A laboratory course in the design of digital circuits. Several projects will be completed involving design with MSI components and hardware and software control of external events with a microprocessor. Students are free to choose their projects according to their interests. PREREQUISITE: EC2800.

EC2990 DESIGN PROJECTS IN ELECTRICAL ENGINEERING (2-4).
Design projects under the supervision of faculty members. Individual or team projects involving the design of devices or systems. A written report is required. PREREQUISITE: Consent of instructor. Graded on Pass/Fail basis only.

EC3210 INTRODUCTION TO ELECTRO-OPTICAL ENGINEERING (3-1).
An overview of the elements that comprise current electro-optical and infrared (EO/IR) systems. Topics include radiation sources (both laser and thermal), detector devices, modulators, optical elements and propagation characteristics. Examples of various simple EO/IR systems are discussed. PREREQUISITE: EC2210 (may be concurrent).



EC3270 POWER ELECTRONICS (3-1).
An introduction to the theory and application of low-power analog and digital devices used in the control of electric power systems found in Shipboard Systems. Applications of power electronics with emphasis on regulators, inverters and rectifiers. PREREQUISITES: EC3370 and differential equations.

EC3310 LINEAR OPTIMAL ESTIMATION AND CONTROL (3-1).
Techniques of optimal control and estimation theory and their application to military systems. Topics include performance measures; dynamic programming, the linear regulator problems; state estimation using observers and Kalman filters; Monte Carlo simulation; combined estimation and control and case studies. PREREQUISITES: EC2300 and EC3410 or EC3500 (either may be concurrent with EC3310).

EC3370 ELECTROMECHANICAL ENERGY CONVERSION (4-0).
Concepts of force and torque developed as results of the interaction of magnetic fields are presented as the common basis for all electromechanical machinery. Fundamental characteristics of DC motors and generators, synchronous machines and induction motors are developed and applied. Transformers and control and distribution circuits are also introduced. PREREQUISITE: A course in circuits.

EC3400 DIGITAL SIGNAL PROCESSING (3-1).
The foundations of digital filtering and signal processing are developed. Topics include Discrete Fourier Transforms (DFTs) and the Fast Fourier Transform (FFT) algorithm, circular convolution and correlation, the use of DFTs and FFTs to evaluate convolution and correlation, spectrum analysis, design methods for nonrecursive and recursive digital filters and signal flow graph and matrix representations. Computer-aided design techniques are emphasized. PREREQUISITES: EC2400 and EC2410.

Jon T. Butler
Professor, Electrical and Computer Engineering

Jon Butler was on the faculty of Northwestern University for 14 years when he took a leave of absence to the Naval Postgraduate School. He was so impressed that, in 1987, he transferred permanently to NPS. His interest is in computer hardware; specifically, he is researching multi-valued logic. "I'm looking at computers that use four levels of logic, instead of two," says Butler. "The basic advantage is a compactness of circuits. This leads to lighter computers and higher speeds."

Butler thinks that NPS provides an ideal environment for faculty in that it accepts people with varying interests and skills. "There are schools where teaching is absolutely important and research is secondary. Here we have outstanding teachers, outstanding researchers and those who are good at both." Butler, a fellow in the IEEE, cites a member of the Computer Science Department faculty: "Professor Richard Hamming, inventor of the Hamming Code and member of the National Academy of Engineering, is a mentor, encouraging people to do their best."

Butler has nothing but praise for the quality of NPS students. "There may be this stereotype of the military student and it's completely wrong. The best students here are every bit as good as students in private universities. SAT scores run very high in the military undergraduate institutions and, since we get many of those students, we're getting the cream of the crop. These students are not one-dimensional; they're eloquent and technically adept. Here there's a balance of math and language among students."

Butler says, "The Naval Postgraduate School is gaining a reputation for technical innovation. Students can come here knowing that NPS is making as solid a contribution to science and engineering as any other high quality institution. This, in turn, encourages students to make significant technical contributions. Also, funding agencies know their research dollars are wisely invested here."

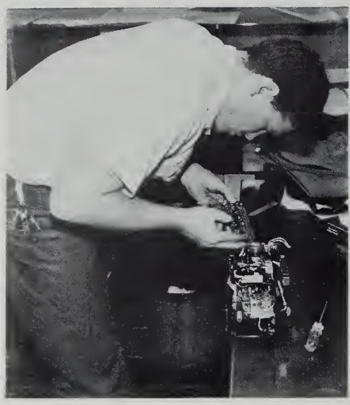
EC3410 DISCRETE-TIME RANDOM PROCESSES (4-0).
Fundamentals of discrete-time random processes are developed from a probabilistic and statistical point of view for digital signal processing, control and communications. Topics covered are random vectors and description of discrete-time random signals, sampling of continuous-time random signals, statistical averages and second moment analysis, linear transformations and fundamentals of estimation theory. Subject matter includes optimal (Wiener) filtering and an introduction to linear prediction and recursive (Kalman) filtering. PREREQUISITES: EC3400 (may be concurrent) and OS2102.

EC3420 STATISTICAL DIGITAL SIGNAL PROCESSING (3-1).
Modern methods of signal processing are developed from a data-oriented point of view. Methods are developed for the processing of random signals through statistical analysis and modeling. Topics include forward and backward linear prediction, autoregressive and moving average signal modeling, lattice structures and an introduction to classical and modern methods of spectral estimation. PREREQUISITE: EC3410 or consent of instructor.

EC3440 IMAGE PROCESSING AND RECOGNITION (3-2).
Subjects introduced in this course include image representation, enhancement, restoration, transformation and encoding. Pattern recognition using statistical decision theory is discussed briefly. Some analysis involving region segmentation and block world understanding will be introduced. Some effort is directed toward robotic vision where contemporary techniques used to recognize objects and extract depth information are dealt with briefly. There will be a series of experiments using special peripherals and computers. PREREQUISITE: EC3400 (may be concurrent).

EC3450 ACOUSTIC FIELD THEORY (4-0).
The objectives of this course are to expose the student to various mathematical techniques (both exact and approximate), special functions (e.g., Bessel functions, Hankel functions, Legendre polynomials, etc.), orthogonality relationships, etc., which will enable him to solve fundamental problems concerning the radiation, scattering and propagation of sound in fluids. Topics to be covered include: general solutions of the three-dimensional Helmholtz wave equation in rectangular, cylindrical and spherical coordinates with Dirichlet, Neumann and Robin boundary conditions; radiation and scattering from cylinders and spheres; sound propagation in the ocean - the WKB approximation, ray acoustics and the parabolic equation approximation; and other topics as time permits. PREREQUISITE: EC2610 or MA3132 or consent of instructor.

EC3500 ANALYSIS OF RANDOM SIGNALS (4-0).
Fundamental concepts necessary for handling non-deterministic signals and noise in communication, control and signal processing systems are developed. Topics include properties of random time functions, statistical averages, autocorrelation and the power spectral density, transform relations, stationarity and ergodicity, noise models. PREREQUISITES: EC2500 and OS2102.



EC3510 COMMUNICATIONS ENGINEERING (3-1).
The influence of noise and interference on the design and selection of hardware in practical communication transmitters and receivers is analyzed. Specific topics include link and signal-to-noise ratio calculations, receiver noise performance for various modulation schemes, bandwidth trade-offs, carrier and data synchronization methods and hardware parameters. PREREQUISITES: EC2220 and EC3500.

EC3550 FIBER OPTIC SYSTEMS FUNDAMENTALS (3-1).
An introduction to the components and to the concepts of designing fiber optic communications systems. Includes fiber properties and parameters, fiber fabrication and testing, LED and injection laser sources, pin photodiodes and avalance photodiode detectors, receiver design considerations, connector and splice techniques and system design incorporating analysis and tradeoffs. Data distribution techniques are also studied. PREREQUISITES: EC2220 and EC2600.

EC3600 ELECTROMAGNETIC RADIATION, SCATTERING AND PROPAGATION (3-2).
The principles of electromagnetic radiation are applied to antenna engineering, propagation and scattering. The characteristics of various practical antennae are considered including arrays and reflectors. Scattering concepts are introduced and propagation phenomena are considered. Applications include sidelobe suppression, radar target scattering, HF and satellite communications. PREREQUISITE: EC2610.

EC3610 MICROWAVE CIRCUITS (3-2).
A continuation of EC2610, the course begins with a discussion of circuit media with emphasis on structures used for MIC's. A study of scattering prameters and applications follows. This material is then used in the study of reciprocal and non-reciprocal components. Circuits with active devices are treated briefly. Use of CAD technique is integrated throughout the course. PREREQUISITE: EC2610.

EC3620 MICROWAVE DEVICES (3-2).
A continuation of EC2610, the course covers microwave solid state and electron tube devices. Circuit and system applications are discussed as well as device physics. Use of CAD technique is integrated throughout the course. PREREQUISITE: EC2610.

EC3630 RADIOWAVE PROPAGATION (3-0).
This course treats the effects of the earth and its atmosphere on electromagnetic waves in the frequency range up to about 300 GHz. Topics covered include ground waves, sky waves, meteor burst, scatter, ducting, reflection, refraction, diffraction, attenuation and fading. Basic theory is covered and computer models are introduced where appropriate. Emphasis is placed on determination of the transmission loss between transmitting and receiving antennae. Antenna parameters are covered briefly. PREREQUISITE: EC2610.

EC3640 ELECTROMAGNETIC ENVIRONMENTAL EFFECTS (3-0).
A project course covering an introduction to sources of electromagnetic interference and techniques for making electronic systems compatible. Conventional Electromagnetic Compatibility (EMC) methods and concepts are examined for receivers, transmitters and antennae in communications, signal processing and radar systems. Newly developed techniques that overcome the shortcomings of classical EMC test procedures and standards are emphasized. PREREQUISITE: EC3600 or EO3760.

EC3650 COMPUTATIONAL ELECTROMAGNETIC MODELING TECHNIQUES (2-2).
Performance predictions for antennae in military systems operating below microwave frequencies are nearly impossible using conventional analytical methods. Recent advances in computers and computational electromagnetics permit efficient numerical analysis of electromagnetic radiating systems. This course introduces students to the methods of moments and finite element techniques developed for military antennae applications. Several EM modeling codes are demonstrated and used to solve typical Navy and Marine Corps antenna problems. Intended for students pursuing research in applied electromagnetics. PREREQUISITE: EC3600 or EO3760.

EC3670 PRINCIPLES OF RADAR SYSTEMS (4-2).
For students in the Avionics and Weapons curricula. Topics include microwave devices, microwave propagation, antenna fundamentals, electronically steerable arrays, pulse radar basics, detection of signals in noise, the radar equation, CW, pulse doppler, moving-target indicators, pulse compression, the ambiguity function, tracking radars, conical scan, track-while-scan, scan with compensation and monopulse. PREREQUISITES: Consent of instructor, U.S. Citizenship and SECRET clearance.

EC3800 MICROPROCESSOR BASED SYSTEM DESIGN (3-2).
Advanced microprocessor system concepts are studied. Topics covered are CPU operation and timing, address decoding, typical LSI support chips, exception processing, design of static and dynamic memory systems, worst-case timing analysis, bus arbitration and direct memory access controllers. The laboratory consists of a design project integrating hardware and software using a state-of-the-art development system. PREREQUISITES: EC2800 and EC2820.

EC3820 COMPUTER SYSTEMS (3-1).
The course presents a unified approach design of computer systems stressing the interacting processes implemented in hardware, software and firmware. General features of operating systems are studied as well as specific features of an existing system. The elements of multiprogramming systems are introduced. PREREQUISITE: EC2800.

EC3830 DIGITAL COMPUTER DESIGN METHODOLOGY (3-2).
A design and project-oriented course. Basic principles, theories and techniques for practical design of digital systems. Emphasizes an integrated viewpoint combining essential elements of classical switching theory with a thorough understanding of the versatility of modern integrated circuits. Laboratory introduces modern design aids. PREREQUISITE: EC2820.

EC3910, EC3920 ... EC3990 TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING (Variable credit) (V-0).
This course examines topics of current interest in electrical and computer engineering. PREREQUISITE: Consent of instructor.

EC4000 FUTURE ENGINEERING PRACTICE (3-0).
This course discusses the fundamental concepts and practices of electrical engineering history, especially computer simulations (including AI), so that students can see trends and make some guesses as to their future. It primarily concentrates on students, their problems in learning new things as technology and careers continue to progress. The course, to some extent, adapts itself to the interests of the students enrolled, but much is a survey of the fundamentals of engineering theory and practice and projections into the future.

EC4100 ADVANCED NETWORK THEORY (3-1).
Modern active circuit design topologies; analog and sampled data networks. Analysis of transfer function properties, stabilities, sensitivities and causalities. Higher order filter design and synthesis. Use of computer simulation tools, SPICE and different device models for network analysis. Transformation methods and switched capacitor filtering and non-filtering applications. Introduction to analog VLSI techniques using stray insensitive switched capacitor networks. PREREQUISITES: EC2210 and EC3400.

EC4210 ELECTRO-OPTIC SYSTEMS ENGINEERING (3-0).
Advanced topics and application of electro-optics. Military applications of infrared technology. Signal-to-noise analysis of laser detector performance. Student reports on EO/IR topics of current interest. PREREQUISITE: EC3210.

EC4300 ADVANCED TOPICS IN MODERN CONTROL THEORY (3-0).
Advanced topics and current developments in control theory and applications including such subjects as: the calculus of variations and Pontryagin's minimum principle applied to optimal control problems; numerical solution of two-point boundary-value problems; nonlinear estimation techniques; robust design techniques; large-scale systems; system identification; case studies of fire control and ship control systems. PREREQUISITE: Consent of instructor.

EC4310 DIGITAL CONTROL SYSTEMS (3-0).
Discrete systems are described and analyzed using time-domain and z-transform methods. Analytical design techniques are studied, as well as the engineering characteristics of computer control systems. PREREQUISITES: EC2400 and 3310.

EC4320 DESIGN OF LINEAR CONTROL SYSTEMS (4-0).
Advanced concepts in the design of linear feedback systems. Frequency response and root locus methods are applied to the design of cascade and feedback compensators for improvement of stability, accuracy and dynamic response. Parameter plane methods are used to place dominant poles while considering both sensitivity and optimization. SISO and MIMO systems are optimized using function minimization subroutines. PREREQUISITE: EC2300.

EC4330 NAVIGATION, MISSILE and AVIONICS SYSTEMS (2-2).
The principles of operation of navigation, missile and avionics systems are presented. Topics are selected from the following areas to address the specific interests of the class: IR, EO, radar, laser and acoustic sensors; inertial platforms; gyros and accelerometers; Loran, Omega, GPS, guidance, fire control and tracking systems. PREREQUISITES: EC3310, U. S. Citizenship and SECRET clearance.

EC4340 NAVIGATION, MISSILE AND AVIONICS SYSTEMS (2-2).
This course covers essentially the same material as 4330, but with deletion of detailed analysis of specific systems. This course is intended for officers who do not have U.S. Citizenship. PREREQUISITE: EC3310.

EC4350 NONLINEAR SYSTEMS (3-2).
Analysis and design of nonlinear systems with phase plane and describing function methods. Accuracy, limit cycles, jump resonances, relay servos and discontinuous systems are considered. PREREQUISITE: EC2300.

EC4360 SYSTEM IDENTIFICATION (3-1).
Design and analysis techniques of control and signal processing systems are based on a mathematical model of the system to be controlled or a model of the environment in which the system is operating. The problem of identifying mathematical models for systems based on input/output signals is addressed. Particular attention is given to linear stochastic autoregressive models of physical systems and techniques to identify their parameters and validate the estimates. Both off line and on line (recursive) identification techniques are presented together with their properties in terms of convergence. PREREQUISITE: EC3310.

EC4370 MATHEMATICAL MODELS AND SIMULATION FOR CONTROL SYSTEMS (4-0).
Modeling concepts and techniques for linear and nonlinear systems. Philosophy of model studies. Verification of the model and its parameter. Design studies using computer models. PREREQUISITE: EC2300.

EC4400 ADVANCED TOPICS IN SIGNAL PROCESSING (3-0).
Special advanced topics in signal processing not currently covered in a regularly scheduled course. Topics may include digital filter structures and implementations, advanced computational topics and architectures for signal processing, imaging, recent work in signal modeling, array processing, or other topics of interest. PREREQUISITE: EC3420 or consent of instructor.

EC4410 SPEECH SIGNAL PROCESSING (3-1).
This course covers methods of digital signal processing as they are applied to speech. Speech signals by nature are stationary only for short periods of time. The production mechanisms and characteristics of speech signals are discussed. Topics include digital speech modeling, analysis by time-domain and short-time Fourier methods, speech synthesis, linear predictive coding of speech and an introduction to speech recognition, speaker recognition, verification and identification. The techniques introduced here have applications in the processing of acoustic signals, transmission line modeling, communications and other block stationary signals. PREREQUISITE: EC3420 or consent of instructor.

EC4420 MODERN SPECTRAL ESTIMATION (3-1).
Classical and modern spectral estimation are developed from their basic ideas and compared in terms of performance and implementation. Topics include Fourier-based, model-based and eigenspace-based estimators, as well as Capon's method and Prony's method. Non-stationary spectral estimation schemes are discussed, in particular the Wigner-Ville distribution and the instantaneous power spectrum. Array processing is discussed from classical, model-based and eigenspace-based perspectives. Additional topics are spectral analysis, higher order spectral estimators and coherency. PREREQUISITE: EC3420 or consent of instructor.

EC4440 MULTIDIMENSIONAL DIGITAL SIGNAL PROCESSING (3-1).
Fundamentals of digital signal processing for signals that are a function of two or more independent variables. Analysis in both the time/space and frequency domains. Areas where the theory of one-dimensional signal processing does not extend in any straight forward way to two or more dimensions are highlighted. Topics include convolution, difference equations, recursively computable systems, sampling, regions of support, multidimensional periodicity, Fourier analysis including discrete Fourier transforms, z-transforms, multidimensional stability and causality and filter design. Application to array processing or other multidimensional signal processing areas (topics may vary). PREREQUISITE: EC3400.

EC4450 SONAR SYSTEMS ENGINEERING (4-1).
Mathematical development and discussion of fundamental principles that pertain to the design and operation of passive and active sonar systems. Topics from complex aperture theory, array theory and signal processing are covered. PREREQUISITES: EC3450 or PH3452 or PH3402 and EC3410 or EC3500 or EO4720.

EC4460 PRINCIPLES OF SYSTEMS ENGINEERING (3-0).
An introduction to the concepts, principles, methodology and techniques of the design of large scale systems. Lecture topics include the systems approach; the system life cycle and system design process; determining system requirements from operational requirements; system effectiveness, reliability, maintainability, safety and logistic support considerations; test and evaluation; and cost as a design parameter. Applications to Navy electronics systems are used to illustrate the subjects covered. A detailed case study analysis of a specific Navy system is performed by the students. PREREQUISITE: Consent of instructor.

EC4470 ADAPTIVE SIGNAL PROCESSING (3-1).
Introduction to the theory of adaptive signal processing for random sequences. Topics to be covered include: review of Weiner filters; one-step forward linear prediction error filters, one step backward linear prediction error filters; analysis and synthesis of lattice prediction-error filters; adaptive tapped-delay-line filters using steepest descent, least mean squares (LMS) and recursive least squares (RLS) algorithms; and adaptive lattice filters. PREREQUISITE: EC3410 or consent of the instructor.

EC4490 OCEAN ACOUSTIC TOMOGRAPHY (3-0).
An introduction to ocean acoustic tomography, an underwater acoustic technique for mapping ocean sound speed and current fields. The course covers the major aspects of ocean acoustic tomography, including the underlying principles, the design and transmission of tomographic signals and linear inverse methods for the reconstruction of ocean fields. PREREQUISITES: EC2410 or OC3150 and EC3450 or OC3260, or PH4453 or equivalent. Also offered as OC4490.

ITY MAGNETRONS

EC4500 ADVANCED TOPICS IN COMMUNICATIONS (3-0).
Advanced topics and current developments in communications including topics such as: m-ary signaling in digital data transmission, packet switching in radio networks, multiple access, computer data links and error control. PREREQUISITE: Consent of instructor.

EC4550 DIGITAL COMMUNICATION (3-0).
This course discusses some of the advantages and limitations of digital communications systems, to include: common modulation formats, matched-filter receivers, probability of error calculations, non-coherent receivers, carrier synchronization, frame and bit synchronization, telephone line modems, inter-symbol interference and adaptive equalizers, wide-band modems, exchange of band-width and signal-to-noise ratio, diversity combining, maximum-likelihood and maximum aposterior probability receivers and channel capacity and finite rate communication with arbitrarily few errors. PREREQUISITE: EC3510.

EC4560 COMMUNICATIONS ECCM (3-2).
Methods of reducing the effects of jamming on radio communications systems are considered. Matched filter and correlator theory and application to spread spectrum techniques of digital data transmission are treated. Synchronization problems and techniques are presented. Codes for error correction are briefly considered. Frequency hopping, time hopping and hybrid systems are studied in addition to direct sequence spreading. Use of steerable null antennas is described. PREREQUISITE: EC3510.

EC4570 DECISION AND ESTIMATION THEORY (4-0).
Principles of optimal signal processing techniques for detecting signals in noise are considered. Topics include Maximum-Likelihood, Bayes Risk, Neyman Pearson and Min-Max criteria and calculations of their associated error probabilities (ROC curves) for signals in Gaussian noise. Principles of Maximum-Likelihood, Bayes Cost, MMSE and Maximum-Aposterior estimators are introduced. Asymptotic properties of estimators and the Cramer-Rao bound are developed. The estimator-correlator structure is derived for detection of signals with unknown parameters. This structure is illustrated by development of the radar(sonar) ambiguity function and matched filter processing systems. State estimation and the Kalman filter are derived and related to MMSE estimators. Emphasis is on dual development of continuous time and discrete time approaches, the latter being most suitable for digital signal processing implementations. PREREQUISITE: EC3410 or EC3500.

EC4580 INFORMATION THEORY (4-0).
Concepts of information measure for discrete and continuous signals. Fundamentals theorems relating to coding and channel capacity. Effects of noise on information transmission. Coding methods for error control in digital communications systems. Selected applications of the theory to systems. PREREQUISITE: EC3410 or EC3500.

EC4590 COMMUNICATION SATELLITE SYSTEMS ENGINEERING (3-0).
Communication satellite systems including the satellite and user terminals. Subjects include orbits, power sources, antennas, stabilization, link calculations, multiple access techniques, modulation and demodulation schemes, phase-locked loops, coding, transponder intermodulation and hardlimiting, receiver design, spread spectrum in SATCOM for multiple access, anti-jam and covert communications. PREREQUISITE: EC3510. (May be concurrent).

EC4600 ADVANCED ELECTROMAGNETIC THEORY (3-0).
An introduction is provided to advanced mathematical and numerical techniques of importance in the design and analysis of electromagnetic devices. Applications to radar scattering, antennas, propagation and microwave devices are covered. PREREQUISITE: Consent of instructor.

EC4610 RADAR SYSTEMS (3-2).
The radar range equation is developed in a form including signal integration, the effects of target cross-section, fluctuations and propagation losses. Modern techniques discussed include pulse compression frequency-modulated radar, MTI, pulse doppler systems, monopulse tracking systems, multiple-unit steerable array radars and synthetic aperture systems. Laboratory sessions deal with basic pulse radar systems from which the advanced techniques have developed, with pulse compression and with the measurements of radar cross section of targets. PREREQUISITES: EC3410 or EC3500, EC3600 and one among EC3610, EC3620 and EC3630; U.S. Citizenship and SECRET Clearance.

EC4620 RADAR SYSTEMS (3-2).
This course covers essentially the same material as EC4610, but with deletions of detailed analysis of specific items. PREREQUISITES: EC3410 or EC3500, EC3600 (or EO3760) and one among EC3610, EC3620 and EC3630. This course is intended for students who do not have U.S. Citizenship.

EC4660 HIGH FREQUENCY TECHNIQUES (4-0).
The high frequency path from transmitter multicoupler to receiver multicouplers. Topics include HF propagation, propagation prediction, sounders, nuclear efforts, ionospheric noise and interference, dynamic range problems, antenna and site effects and target location techniques. PREREQUISITES: EC3600, or consent of instructor; U.S. Citizenship and SECRET clearance.

EC4670 ELECTRONIC WARFARE (4-1).
This course is intended for students who are not in the Electronics or Communications Engineering curricula. Three lecture hours are shared with EC4680. In addition to the topics listed under EC4680, background material on communication theory and digital signal processing is presented. PREREQUISITES: EC3670, U.S. Citizenship and SECRET clearance.

EC4680 ELECTRONIC WARFARE TECHNIQUES AND SYSTEMS (3-3).

Active and passive countermeasure techniques are considered, including signal representation, signal analysis and signal interception. Important parameters of radar and communications systems are defined. Denial and deceptive jamming techniques are considered along with countermeasure and counter-countermeasure techniques. Signal intercept systems are treated. Acoustic, radio-frequency, infrared and optical countermeasures are discussed. PREREQUISITES: EC4610, U.S. Citizenship and SECRET clearance.

EC4690 PRINCIPLES OF ELECTRONIC WARFARE (3-2).

For students who do not have U.S. Citizenship. The objectives are to define EW signals and systems parameters and establish interrelationships of these parameters for active and passive EW systems. Topics included are signal waveforms and spectra, receivers, signal processing and display, jamming techniques, direction finding, deception and confusion techniques. Laboratory exercises apply the basic principles of jamming and CCM to radar systems. PREREQUISITE: EC4620.

EC4800 ADVANCED TOPICS IN COMPUTER ARCHITECTURE (3-0).

Advanced topics and current developments in computer architecture including such subjects as: RISC vs. CISC; graphics processors and work stations; supercomputers and mini-supercomputers; computer structures for artificial intelligence; massively parallel architectures. PREREQUISITE: Consent of instructor.

EC4820 COMPUTER ARCHITECTURES (3-1).

A study of advances in computer architecture. Computer descriptive languages. Memory system issues. Mini-computer and bit-slice microcomputers. High performance computers: pipeline supercomputers, array processors, multiprocessors. Data flow architectures. Fault tolerant and military architectures. PREREQUISITES: EC3800 and EC3820.

EC4830 DIGITAL COMPUTER DESIGN (3-1).

A study of the architecture of and the design process for digital computer systems. Topics covered will include instruction set architectures, advanced computer arithmetic, hierarchical design techniques, design of systems using standard and custom VLSI devices, Modern computer aided-design tools are emphasized. Laboratory project is the design of a digital computer. PREREQUISITES: EC3800 and EC3830.

EC4850 COMPUTER COMMUNICATION METHODS (3-0).

The course objective is to develop an understanding of computer communications network design. Coverage includes the essential topics of network topology, connectivity, queuing delay, message throughput and cost analysis. The International Standards Organization (ISO) model is divided into physical link, data link, network, transport, session and application layers. The protocol of these layers, data framing, error control, flow control, packet assembly/disassemble, routing, congestion, virtual circuit connection are discussed. New lower networking technologies such as Ethernet, ring, satellite link, X.25 public packet switching are introduced. PREREQUISITE: EC3500.

EC4870 VLSI SYSTEMS DESIGN (3-2).
An introduction to the architecture and design of very large scale integrated systems. A structured approach to system design is developed emphasizing CMOS devices and circuits. Basic cells, state machines and their application to highly regular topologies are studied. Several examples of complete VLSI systems are presented. Project work is oriented to the definition, planning, design and testing of a complete small system. PREREQUISITES: EC3800 and EC3830.

EC4900 SPECIAL TOPICS IN ELECTRICAL ENGINEERING (Variable hours 2-0 to 5-0) (V-0).
Supervised study in selected areas of electrical engineering to meet the needs of the individual student. A written report is required at the end of the quarter. PREREQUISITE: Consent of the department Chairman. Graded on Pass/Fail basis only.

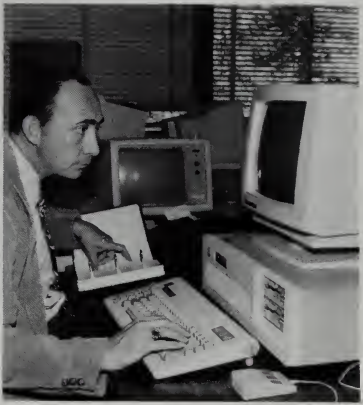
EC4910, EC4920 ... EC4990 SPECIAL TOPICS IN ELECTRICAL ENGINEERING (Variable credit) (V-0).
This course examines advanced topics of current interest in electrical and computer engineering. PREREQUISITE: Consent of instructor.

EO2710 INTRODUCTION TO SIGNALS AND SYSTEMS (4-2).
A first course in communications systems for the C3, Space Systems Operations and Telecommunications Management curricula. Coverage begins with the representation of signals in the time and frequency domains and progresses through linear system analysis using Fourier transform theory. Analog modulation techniques are presented emphasizing communications systems level analysis and spectral representation. Topics include Fourier series, Fourier transforms, linear systems, filters, signal bandwidth, communications channels and amplitude, frequency and phase modulation. PREREQUISITE: MA1248.

EO2720 INTRODUCTION TO ELECTRONIC SYSTEMS (4-2).
A first course in electronic systems for the ASW and EW systems curricula. Emphasis is on the functional aspects of basic circuits and signals. Topics include electrical quantities, resistive circuits, inductance and capacitance, operational amplifiers, time and frequency response, rectifiers and logic elements. PREREQUISITE: Calculus.

EO2730 CONTROL SYSTEMS (2-1).
This course develops the basic tools of the control systems engineer. The applications to electronic warfare are emphasized in the examples and laboratory experiments. The dynamics for a radar control system, a missile seeker head tracking system and missiles are investigated. Basic topics are introduced such as signal flow graphs and system step and frequency response characteristics and digital systems theory as used in radar tracking and command guided and semiactive homing missiles. PREREQUISITES: Differential equations, Laplace transform and FORTRAN.

EO2750 COMMUNICATIONS SYSTEMS (4-2).
A second course in communications systems for the C3, Space Operations and Telecommunications Management curricula. Coverage begins with the sampling theorem and various forms of digital modulation emphasizing the spectral representation of digital and pulse signals. Noise is introduced with emphasis on its effects on a communication system. Specific topics include sampling, pulse-amplitude modulation, time-division multiplexing, pulsecode modulation, baseband encoding, phase-shift keying, noise temperature, noise figure and signal-to-noise ratio. PREREQUISITE: EO2710.



EO2760 ELECTROMAGNETIC THEORY (4-1).
The experimental laws of electromagnetic theory and the development of Maxwell's equations are presented. Maxwell's equations are then utilized in the study of plane waves, transmission lines, wave guides, cavity resonators and elementary radiation. Laboratory experiments dealing with high frequency components and measurements reinforce and extend the concepts presented in the lectures. PREREQUISITES: EO2720 and MA2047.

EO2790 SURVEY OF COMMUNICATIONS SYSTEMS (4-0).
This course supports the Intelligence curriculum by providing an overview of the principles, concepts and trade-offs underlying communications systems. Topics include: signals and their representation as functions of time and frequency, effects of bandwidth limitations upon signals, analog and digital modems, signal-to-noise considerations in communications systems, reliable communications path concepts, major communications system design trade-offs and examples of modern communications systems.

EO3720 INTRODUCTION TO SIGNALS AND NOISE (4-1).
A course in the analysis of signals and noise for the ASW and EW Curricula. Topics include Fourier analysis of periodic and pulse signals, linear filter response, correlation and spectral density of random signals and sampling. PREREQUISITES: EO2720 and a first course in probability.

EO3740 SPACE POWER AND RADIATION EFFECTS (3-1).
Fundamentals of different power systems utilized in spacecrafts; photovoltaic power technology; solid state physics, silicon solar cells, solar cell measurement and modeling, gallium arsenide cells and III-V compounds in general, array designs and solar dynamics. Radiation effects on solid state devices and materials. Survivability of solar cells and ICs in space environment and annealing methods. Other space power systems including chemical and nuclear (radioisotope thermoelectric generators and nuclear reactors). Energy storage devices and power conversion. Spacecraft power supply design. PREREQUISITES: SS2001 and EC2200.

EO3750 COMMUNICATIONS SYSTEM ANALYSIS (3-1).
The final course in communications systems for the C3, Space Systems Operations and Telecommunications Management Curricula. The objective is to study communications from a system perspective concentrating on the relative performance of several important communication systems and the analysis of trade-offs available in the design of communications systems. Specific topics introduced include relative performance of modulation types in noise, bit error rates, error detection and correction, signal-to-noise ratio, antenna characteristics, propagation and path calculations. Special subjects will be introduced and existing knowledge reinforced through the study of existing military communication systems. PREREQUISITE: EO2750.

EO3760 ELECTROMAGNETIC RADIATION, SCATTERING AND PROPAGATION (4-2).
The fundamentals of antennas used in the VLF through the microwave portion of the electromagnetic spectrum are presented. Scattering and propagation in this part of the spectrum are also discussed, as are those elements of electromagnetic compatibility which relate to radiation. Laboratory exercises relating to pattern and impedance measurement and use of computer programs further enhance the student's understanding of the lecture concepts. PREREQUISITE: EO2760.

EO3780 ELECTRONIC WARFARE COMPUTER APPLICATIONS (3-2).
Application of digital and analog techniques to the recording, processing, display and interpretation of electronic warfare signals and data. The computer is applied to the solution of electronic warfare problems such as signal identification. PREREQUISITES: EC2810, CS3510, or CS3230; EO4780.

EO4720 SIGNAL PROCESSING SYSTEMS (4-1).
A study of digital, analog and hyband signal processing systems for communications, echo ranging and electronic surveillance. Examples from current and proposed military systems will be analyzed. The course is designed for the ASW and EW curricula. PREREQUISITE: EO3720.

EO4730 ELECTRO-OPTIC SYSTEMS AND COUNTERMEASURES (3-0).
A study of military applications of electro-optic systems, IR and EO missile seekers, laser designators, optical surveillance, high energy laser systems, laser communications and laser radar. Emphasis is on system applications, countermeasures and counter-countermeasures. Students report on electro-optic systems. PREREQUISITES: EC3210 or PH3208, U.S. Citizenship and SECRET clearance.

EO4760 MICROWAVE DEVICES AND RADAR (4-2).
Those microwave devices most important in radar and in electronic warfare systems are studied, including magnetrons, traveling-wave tubes and solid-state diodes. The radar range equation is developed. In addition to basic pulse radar, modern techniques are discussed including doppler systems, tracking radar, pulse compression and electronically steerable array radars. Electromagnetic compatibility problems involving radar systems are considered. Laboratory sessions deal with basic pulse radar systems from which the advanced techniques have developed, with performance measurement methods, automatic tracking systems, pulse compression and the measurement of radar cross-section of targets. PREREQUISITES: EO4720, EO3760 (may be taken concurrently) or consent of instructor, U.S. Citizenship and SECRET clearance.

EO4780 ELECTRONIC WARFARE SYSTEMS (3-2).
This course covers electronic warfare in that portion of the electromagnetic spectrum through the millimeter wavelength region. The infrared through electro-optic region is covered in a companion course, EO4730. Electronic denial and deceptive countermeasures against fuses, communications and various radar detection and tracking systems are discussed. Equations for required jammer gain and power output are developed. The characteristics of passive countermeasures are discussed. Other topics include anti-radiation missiles, counter-countermeasure circuits, target masking and modification, signal intercept, signal sorting, signal identification and direction finding. Techniques are discussed in relation to U.S., allied and communist bloc systems. Laboratory work reinforces the classroom discussions. PREREQUISITES: EO4760, U.S. Citizenship and SECRET clearance.

EO4790 C3 COUNTERMEASURES (Variable credit) (V-0).
Supervised study in selected areas of electronic warfare to meet the needs of individual students. A written report is required at the end of the quarter. PREREQUISITE: Consent of C3 Group Chairman. Graded on a Pass/Fail basis only.

ELECTRONIC WARFARE ACADEMIC GROUP

Chairman:
Joseph Sternberg,
Professor,
Code EW, Spanagel Hall,
Room 202,
(408) 646-2214,
AV 878-2214.

Academic Associate:
Jeffrey B. Knorr,
Professor,
Code EC/Ko, Spanagel Hall,
Room 428,
(408) 646-2677,
AV 878-2677.

Alfred William Madison Cooper, Professor (1957)*; PhD, The Queen's University of Belfast, 1961.

Kenneth L. Davidson, Professor (1970); PhD, University of Michigan, 1970.

Wayne Philo Hughes, Jr., Adjunct Professor (1979); MS, Naval Postgraduate School, 1964.

Jeffrey B. Knorr, Professor (1970); PhD, Cornell University, 1970.

Michael A. Morgan, Professor (1979); PhD, University of California at Berkeley, 1976.

Arthur Loring Schoenstadt, Professor (1970); PhD, Rensselaer Polytechnic Institute, 1968.

Joseph Sternberg, Professor (1985); PhD, Johns Hopkins University, 1955.

Harold A. Titus, Professor (1962); PhD, Stanford University, 1962.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

The Electronic Warfare Academic Group is an interdisciplinary association of faculty consisting of eight members representing five separate academic disciplines. An academic group is a less formal organization than an academic department and each professor in the group has an appointment in an academic department. The Electronic Warfare Academic Group has administrative responsibility for the academic content of the Electronic Warfare Program of study. Teaching in this multidisciplinary program is carried out by faculty members attached to the following academic departments: Electrical and Computer Engineering, Mathematics, Meteorology, Operations Research and Physics. Thesis topics for students in this area of study are approved by the group and the final thesis is approved by the chairman.

MASTER OF SCIENCE IN SYSTEMS ENGINEERING

The degree Master in Science in Systems Engineering (Electronic Warfare) will be awarded at the completion of a multidisciplinary program, either Curriculum 595 or 596, satisfying the following degree requirements:

The Master of Science in Systems Engineering requires a minimum of 45-quarter hours of graduate-level work of which at least 15 hours must represent courses at the 4000 level. Graduate courses in at least four different academic disciplines must be included and in two disciplines, a course at the 4000 level must be included.

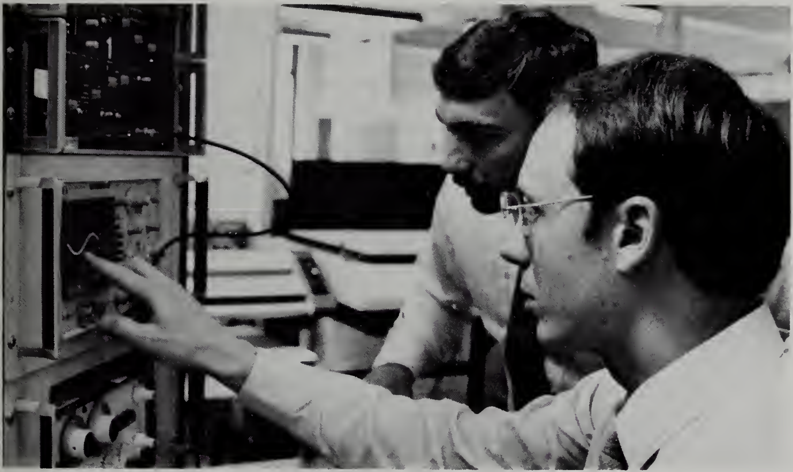
An approved sequence of at least three courses constituting advanced specialization in one area must be included.

In addition to the 45 hours of course credit, an acceptable thesis must be completed.

OURSE OFFERINGS

W0002 SEMINAR (No Credit) (0-1).
pecial lectures and discussion of matters related to the Electronic arfare program. PREREQUISITE: SECRET clearance.

W0810 THESIS RESEARCH/GROUP PROJECT (0-0).
tudents in the Systems Engineering curriculum will enroll in this ourse which consists of an individual thesis or a group project involvg several students and faculty.



ENGINEERING ACOUSTICS ACADEMIC COMMITTEE

Chairman:
Anthony A. Atchley,
Associate Professor,
Code PH/Ay, Spanagel,
Hall, Room 101H,
(408) 646-2848,
AV 878-2848.

The academic character of the programs in Engineering Acoustics is interdisciplinary, with courses and laboratory work drawn principally from the fields of physics and electrical engineering. Although broadly based, the emphasis of the programs is on those aspects of acoustics, signal processing and computers related to underwater sound propagation, electro-acoustic transduction and the detection, tracking and quieting of underwater targets. These programs are designed specifically for students in the Underwater Acoustics curriculum and government employees in acoustics-related laboratories and systems commands.

The academic aspects of the program are the responsibility of an academic committee composed of representatives from the Department of Physics and of Electrical and Computer Engineering.

MASTER OF SCIENCE IN ENGINEERING ACOUSTICS

The degree Master of Science in Engineering Acoustics will be awarded as an interdisciplinary program to be carried out in accordance with the following degree requirements:

1) A student pursuing a program leading to a Master of Science in Engineering Acoustics must have completed work which would qualify him/her for a Bachelor of Science degree in engineering or physical science. Credit requirements for the Master of Science degree must be met by courses in addition to those used to satisfy this requirement.

2) The Master of Science in Engineering Acoustics requires a minimum of 36-graduate credit quarter hours of course work; at least 20-graduate quarter hours must be taken in acoustics and its applications. One 4000 level course from each of three of the following areas must be included: wave propagation, transducer theory and design sonar systems and signal processing.

3) An acceptable thesis must be completed.

Approval of each program by the Engineering Acoustics Academic Committee must be obtained prior to reaching the mid point of the degree program.

DOCTOR OF PHILOSOPHY AND DOCTOR OF ENGINEERING

The Department of Electrical Engineering and Physics jointly sponsor an interdisciplinary program in Engineering Acoustics leading to either the degree Doctor of Philosophy or Doctor of Engineering. Areas of special strength in the departments are physical acoustics, ocean acoustics and acoustic signal processing. A noteworthy feature of this program is that a portion of the student's research may be conducted away from the Naval Postgraduate School at a cooperating laboratory or other Federal Government installation. The degree requirements and examinations are as outlined under the general school requirements for the doctor's degree. In addition to the school requirements, the departments require a preliminary examination to show evidence of acceptability as a doctoral student.

DEPARTMENT OF MATHEMATICS

Donald Barr, Adjunct Professor (1990)*; PhD, Colorado State University, 1965.

C. Sue Brown, Adjunct Professor (1989); PhD, University of Texas at Arlington, 1989.

David Canright, Assistant Professor (1988); PhD, University of California at Berkeley, 1987.

Donald Alfred Danielson, Associate Professor (1985); PhD, Harvard University, 1968.

Richard Homer Franke, Professor (1970); PhD, University of Utah, 1970.

Ismor Fischer, Adjunct Professor (1990); PhD, University of Wisconsin, 1989.

Harold M. Fredricksen, Chairman and Professor (1980); PhD, University of Southern California, 1968.

Christopher Frenzen, Associate Professor (1989); PhD, University of Washington, 1982.

Mostafa Ghandehari, Assistant Professor (1988); PhD, University of California at Davis, 1983.

William Gragg, Professor (1987); PhD, University of California at Los Angeles, 1964.

Kim Hefner, Assistant Professor (1988); PhD, University of Colorado, 1988.

Teresa Henson, Adjunct Professor (1991); MS, University of Colorado at Denver, 1989.

Van Henson, Assistant Professor (1991); PhD, University of Colorado at Denver, 1990.

Toke Jayachandaran, Associate Dean of Faculty and Graduate Studies, Professor (1967); PhD, Case Institute of Technology, 1967.

Gordon Eric Latta, Professor (1979); PhD, California Institute of Technology, 1951.

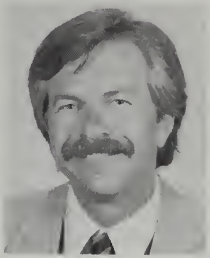
Jeffery Leader, Assistant Professor (1990); PhD, Brown University, 1989.

Levi Lustman, Adjunct Professor (1989); PhD Tele Aviv University, 1978.

Beny Neta, Associate Professor (1985); PhD, Carnegie-Mellon University, 1977.

Guillermo Owen, Professor (1983); PhD, Princeton University, 1962.

Ira Bert Russak, Associate Professor (1972); PhD, University of California at Los Angeles, 1967.



Chairman:
Harold M. Fredricksen,
Professor,
Code MA/Fs, Ingersoll Hall,
Room 344,
(408) 646-2206,
AV 878-2206.

Associate Chairmen:

Labs and Computing
Toke Jayachandran,
Professor,
Code MA/Jy, Ingersoll Hall,
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AV 878-2600.

Research and Recruiting
Beny Neta, Professor,
Code MA/Nd, Ingersoll Hall,
Room 348,
(408) 646-2235,
AV 878-2235.

Instruction
Maurice D. Weir, Professor,
Code MA/Wc, Ingersoll Hall,
Room 335,
(408) 646-2608,
AV 878-2608.

Clyde Scandrett, Assistant Professor (1987); PhD, Northwestern University, 1985.

Arthur Loring Schoenstadt, Professor (1970); PhD, Rensselaer Polytechnic Institute, 1968.

Aaron Schusteff, Adjunct Professor (1990); PhD, University of California at Los Angeles, 1989.

John Thornton, Assistant Professor (1989); PhD, Clemson University, 1989.

Maurice Dean Weir, Professor (1969); DA, Carnegie-Mellon University, 1970.

Carroll Orville Wilde, Professor (1968); PhD, University of Illinois, 1964.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

As well as the master of science degree, the Mathematics Department offers individually tailored minor programs for many of the school's doctoral students. The majority of the departmental effort is devoted to the service courses offered, including the refreshers and 1000-2000 level courses. The department maintains a microprocessor lab for purposes of instruction.

MASTER OF SCIENCE IN APPLIED MATHEMATICS

In order to enter a program leading to the degree Master of Science in Applied Mathematics, a student must be qualified by background for a Bachelor of Science degree with a major in mathematics or with a strong mathematical orientation in physical science or engineering.

A program that leads to the degree Master of Science in Applied Mathematics for a student who has met the entrance criteria must contain a minimum of 45-quarter hours of graduate-level courses with a minimum QPR of 3.0, subject to the following conditions:

1) The program must be approved by the Chairman of the Department of Mathematics.

2) The program must include at least fifteen hours at the 4000 level, with at least twelve hours in 4000 level mathematics courses.

3) The program must contain at least nine hours in an approved sequence of application courses from outside the Mathematics Department and at least nine hours in an approved sequence of courses from within the Mathematics Department.

4) An acceptable thesis is normally required and is credited as the equivalent of nine hours of 3000 level mathematics courses. (A student receiving a dual masters and writing a thesis in another department may petition the Chairman of the Mathematics Department to substitute nine hours of courses for the thesis.)

5) Courses in the following areas are specifically required in any program; some of these courses may be used to satisfy part (or all) of the mathematics sequence requirement in item (3) above:

   a. Real/Complex Analysis (a two-course sequence) or Applied Algebra (a two-course sequence);

   b. Ordinary and/or Partial Differential Equations and Integral Transforms;

   c. Numerical Analysis;

   d. Probability and Statistics;

   e. Linear Algebra (a two-course sequence);

   f. Mathematical Modeling Processes.

COURSE SEQUENCES FOR SPECIAL CURRICULA

The Mathematics Department offers several sequences of courses for various curricula. Students of these curricula typically enter these sequences at their appropriate level and exit when completing their particular requirements.

COMPUTER SCIENCE

MA 2025
MA 3026

MANAGEMENT

MA 2300

OPERATIONAL CURRICULA

MA 2138
MA 3139

ENGINEERING SCIENCE

MA 1117
MA 1118
MA 2047/2089
MA 2121
MA 3132
MA 3232

OPERATIONS RESEARCH

MA 1118
MA 2042
MA 3110

PREREQUISITES

Prerequisites are as described in the course descriptions. If a student has not taken the prescribed prerequisites at NPS, then a validation examination by the Mathematics Department may be substituted.

Generally speaking, credit for courses given in sequences will not be available to every student. Credit will be given for only one of a pair of equivalent courses.

COURSE OFFERINGS

MA0117 REFRESHER: SINGLE VARIABLE CALCULUS (NO CREDIT) (Meets last 6 weeks of quarter). (3-3).
Single variable calculus review.

MA0118 REFRESHER: MULTIVARIABLE CALCULUS (NO CREDIT) (Meets last 6 weeks of quarter). (3-3).
Multivariable calculus review.

MA0125 INTRODUCTION TO FINITE MATHEMATICS (NO CREDIT) (Meets last 6 weeks of quarter) (3-0).
An introduction to the elements of set theory and mathematical reasoning. Sets, Venn diagrams, truth tables, quantifiers, logical reasoning. Functions, relations, partitions and equivalence relations. 1-1 correspondence. Applications of finite mathematics such as finite difference equations, counting problems, geometric linear programming and so forth are included.

MA0142 REFRESHER: MATRIX ALGEBRA (NO CREDIT). (Meets last six weeks of quarter) (2-0).
The fundamental algebra of matrices including addition, multiplication of matrices, multiplication of a matrix by a constant and a column (vector) by a matrix. Elementary matrices and inverses, together with the properties of these operations. Solutions to mxn systems of linear algebraic equations are also investigated including Gaussian elimination and the LU decomposition of a matrix (without pivoting). Determinants, properties of determinants and Cramer's rule for solving square systems. A brief introduction to the arithmetic of complex numbers and DeMoivre's theorem.

MA0810 THESIS RESEARCH (0-0).
Every student conducting thesis research will enroll in this course.

MA1042 MATRIX ALGEBRA (2-0).
The fundamental algebra of matrices including addition, multiplication of matrices, multiplication of a matrix by a constant and a column (vector) by a matrix. Elementary matrices and inverses, together with the properties of these operations. Solutions to mxn systems of linear algebraic equations are also investigated including Gaussian elimination and the LU decomposition of a matrix (without pivoting). Determinants, properties of determinants and Cramer's rule for solving square systems. A brief introduction to the arithmetic of complex numbers and DeMoivre's theorem.

MA1117 SINGLE VARIABLE CALCULUS (5-2).
Review of analytic geometry and trigonometry, functions of one variable, limits, derivatives, continuity and differentiability; differentiation of algebraic, trigonometric, logarithmic and exponential functions with applications to maxima and minima, rates, differentials; product rule, quotient rule, chain rule; anti-derivatives, integrals and the fundamental theorem of calculus; definite integrals, areas, lengths of curves and physical applications; special methods of integration, including a 2 hour problem solving laboratory. PREREQUISITE: Precalculus mathematics.

MA1118 MULTI-VARIABLE CALCULUS (5-2).
Review of calculus of one variable; vector algebra and calculus, directional derivative, gradient and integral theorems; maxima and minima of functions of two independent variables, total differential; double and triple integrals, cylindrical and spherical coordinate systems; infinite series, convergence tests and Taylor series, including a 2 hour problem solving laboratory. PREREQUISITE: Previous course in calculus.

MA1248 SELECTED TOPICS IN APPLIED MATHEMATICS FOR C3, SPACE OPERATIONS AND COMMUNICATIONS MANAGEMENT (4-1).
A survey of selected calculus and post calculus topics - infinite sequences and series; Fourier series and Fourier integral transforms; and matrix algebra and determinants. (This course may not be taken for credit by students in an engineering or science degree program). PREREQUISITE: MA1117.

MA2025 BRIDGE TO ADVANCED MATHEMATICS (4-1).
Propositional and predicate logic, elements of set theory, relations, functions and partitions. An introduction to theorem proving techniques, including mathematical induction, in the context of basic mathematical systems applied to computer science.

MA2042 LINEAR ALGEBRA (4-0).
Review of systems of linear equations, matrices and determinants. Finite dimensional vector spaces, linear dependence, basis, dimension, inner products, orthogonalization. Linear transformations, rank and nullity, change of basis, linear functionals, orthogonal transformations, quadratic forms, symmetric matrices, diagonalization, eigenvalues and eigenvectors. PREREQUISITES: MA1118 taken concurrently, MA1042.

MA2047 LINEAR ALGEBRA AND VECTOR ANALYSIS (4-1).
Solutions of linear systems of equations, algebra of matrices, determinants. Linear vector spaces, linear dependence and independence, subspaces, bases and dimension. Inner products, orthonormal bases and Gram-Schmidt process. Eigenvectors and eigenvalues. The algebra and calculus of vectors in R2 and R3. Del operator, divergence and curl with applications. Line and surface integrals; Green's, Stoke's and divergence theorems. PREREQUISITE: MA1118.

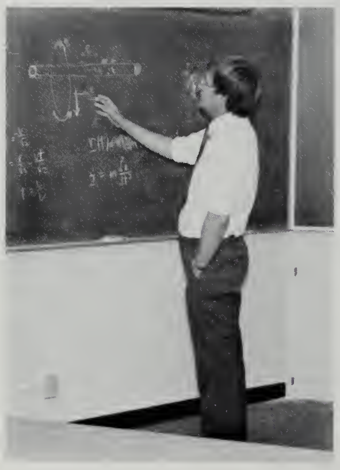
MA2089 VECTOR ANALYSIS WITH MATRIX ALGEBRA (4-1).
The calculus of vectors in R2 and R3. Del operator, divergence and curl with applications to physics. Line and surface integrals, Green's, Stoke's and divergence theorems. Solutions of linear systems of equations, algebra of matrices. Linear independence, dot and cross products in R3, bases and the Gram-Schmidt process. Eigenvalues and eigenvectors with applications to physics. PREREQUISITE: MA1118.

MA2121 DIFFERENTIAL EQUATIONS (4-0).
Ordinary differential equations: linear and nonlinear (first order) equations, homogeneous and non-homogeneous equations, linear independence of solutions, power series solutions, systems of differential equations, Laplace transforms. Applications. PREREQUISITES: MA1118 or equivalent, MA2047 or equivalent concurrently.

MA2138 SELECTED TOPICS FROM CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS (5-0).
Partial derivatives, directional derivatives, tangent planes. Multiple integrals in rectangular, polar, cylindrical and spherical coordinates. First order ordinary differential equations, second order linear equations with constant coefficients, Laplace transforms. Applications. For ASW and EW students only. PREREQUISITE: MA1117 or equivalent.

MA2300 MATHEMATICS FOR MANAGEMENT (5-0).
Mathematical basis for modern managerial tools and techniques. Elements of differential and integral calculus. Introduction to matrix algebra and solutions of linear systems of algebraic equations. PREREQUISITE: College algebra.

MA3001 INCREMENTED DIRECTED STUDY (1-0).
Provides the opportunity for a student who is enrolled in a 3000-level course to pursue the course material in greater depth by directed study to the extent of one additional hour beyond the normal course credit.



MA3002 INCREMENTED DIRECTED STUDY (2-0).
Provides the opportunity for a student who is enrolled on a 3000-level course to pursue the course material in greater depth by directed study to the extent of two additional hours beyond the normal course credit.

MA3026 DISCRETE MATHEMATICS (5-0).
Graphs, trees, matchings and network flows. Introduction to combinatorial problems and counting techniques. Recurrence relations. Combinatorial circuits and introduction to finite state machines. Applications to computer science. PREREQUISITE: MA2025.

MA3035 MATHEMATICAL INTRODUCTION TO MICROPROCESSORS (See SS3035 for Space Engineering Students) (2-2).
An introduction to microprocessors at the hardware/software interface. Machine language programming, assembly language programming, connecting and controlling peripherals (terminal, disc drive...), operating systems.

MA3046 MATRIX THEORY AND COMPUTATIONAL LINEAR ALGEBRA (Replaces prior MA3046 and MA3047) (4-1).
Review of linear algebra from a computationally constructive and geometric point of view: Gauss, factorization, fundamental theorem of linear algebra. Linear least squares problems via modified Gram-Schmidt and Householder QR factorizations. Algorithms for updating matrix factorizations: application to linear programming. Hermitian eigenproblems and singular value decompositions via the QR algorithm and divide-and-conquer algorithms. Lanczos and Arnoldi processes. Structured problems arising in signal processing: fast Fourier transforms, Toeplitz systems, orthogonal eigenproblems. Coding of algorithms using Matlab. PREREQUISITE: MA2042 or consent of instructor.

MA3110 INTERMEDIATE ANALYSIS (4-0).
Multi-variable calculus integrated with linear algebra. Functions of several variables, continuous transformations, Jacobians, chain rule, implicit function theorem, inverse function theorem, extrema, Lagrange multiplier technique, curvilinear coordinates, convexity. PREREQUISITES: MA1118 or equivalent, MA2042 or equivalent.

MA3132 PARTIAL DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS (4-0).
Solution of boundary value problems by separation of variables; Sturm-Liouville problems; Fourier, Bessel and Legendre series solutions, Fourier transforms; classification of second order equations; applications, method of characteristics. PREREQUISITE: MA2121 or equivalent.

MA3139 FOURIER ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS (4-0).
Fourier series; solution of the one and two-dimensional wave equations, D'Alembert's solution, frequency and time domain interpretations; Fourier integral transforms and applications to ordinary and partial differential equations and linear systems; Convolution theorems. For ASW and EW students. PREREQUISITE: MA2138.

MA3185 TENSOR ANALYSIS (3-0).
Definition of tensor as linear function of vectors, invariant under change of coordinates. Dyadic representation of tensor in arbitrary coordinate systems with covariant or contravariant base vectors. Tensor calculus. Cartesian tensor notation. Tensors used in various applications: stress, rotation, inertia, momentum-flux, metric, Riemann-Christoffel, electromagnetic field, etc.. PREREQUISITE: MA2047 or equivalent.

MA3232 NUMERICAL ANALYSIS (4-1).
Solution of nonlinear equations, zeros of polynomials. Interpolation and approximation. Numerical differentiation and quadrature. Matrix manipulations: linear simultaneous, algebraic equations, eigenvalues. Numerical solutions of ordinary differential equations. Analysis for computational errors. PREREQUISITES: MA2121 or equivalent (may be taken concurrently) and FORTRAN programming.

MA3243 NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS (4-1).
Finite difference approximations for derivatives. Truncation and discretization errors. Parabolic and hyperbolic equations. Explicit and implicit methods. The Crank-Nicolson method. Approximations at irregular boundaries. Elliptic equations, the Liebmann method. Systems of partial differential equations. Students are expected to write FORTRAN programs for the above methods. PREREQUISITES: MA3132 and FORTRAN programming.

MA3393 TOPICS IN APPLIED MATHEMATICS (Variable hours 1-0 to 4-0) (V-0).
A selection of topics in applied mathematics. The course content varies and the credit varies. This course is intended to reflect study for the beginning graduate student in an area for which no formal course is taught. Credit for this course may be granted more than one time to an individual student. PREREQUISITE: Consent of instructor.

MA3400 MATHEMATICAL MODELING PROCESSES (4-0).
Practice model construction while demonstrating the utility and universality of mathematics. Topics include modeling using graphical analysis, the model building process, modeling using proportionality, analysis of data, modeling using dimensional analysis, dynamical models, optimization of models and simulation. PREREQUISITE: MA1118 or MA2300 or consent of instructor.

MA3560 MODERN APPLIED ALGEBRA (3-0).
The techniques and tools of abstract algebra with special emphasis on applications to coding theory, communications systems and computer science. Elements of set theory, equivalence relations and partitions. Semi-groups, groups, subgroups and homomorphisms. Ring, ideals and fields. Directed graphs and lattices. Applications may vary. PREREQUISITE: MA2042 or consent of instructor.

MA3565 MODERN ALGEBRA (3-0).
An advanced course in the subject of abstract algebra. Semi-groups, groups, subgroups, normal subgroups. Groups acting on sets, operator groups. The Jordan-Holder Theorem, solvable groups. The Krull-Schmidt Theorem. PREREQUISITE: Consent of instructor.

MA3605 FUNDAMENTALS OF ANALYSIS I (3-0).
The real number system and the usual topology of En; properties of continuous functions; differentiation. Functions of bounded variation and theory of Reiman-Stieltjes integration, convergence theorems for sequence and series of functions. PREREQUISITE: MA3110 or consent of instructor.

MA3606 FUNDAMENTALS OF ANALYSIS II (3-0).
Continuation of MA3605. PREREQUISITE: MA3605.

MA3610 INTRODUCTION TO GENERAL TOPOLOGY (3-0).
Topologies, bases and subbases, compactness and connectivity. Metrization and embeddings. Convergence and nets or filters. Tychonoff product theorem, Alexandroff and Stone Cech compactification. Fractals. PREREQUISITE: MA3605 or consent of instructor.

MA3675 THEORY OF FUNCTIONS OF A COMPLEX VARIABLE I (3-0).
Selected topics from the theory of functions of a real variable; complex functions, power series, Laurent series. Singularities of complex functions; residues and contour integration; zeros of analytic functions, factors of and infinite product representation for analytic functions; maximum modulus theorems for analytic and harmonic functions; conformal mapping. PREREQUISITES: MA1118 and consent of instructor.

MA3676 THEORY OF FUNCTIONS OF A COMPLEX VARIABLE II (3-0).
Continuation of MA3675. PREREQUISITE: MA3675.

MA3730 THEORY OF NUMERICAL COMPUTATION (3-0).
Analysis of computational methods used for the solution of problems from the areas of algebraic equations, polynomial approximation, numerical differentiation and integration and numerical solutions of ordinary differential equations. PREREQUISITE: Consent of instructor.

MA4026 COMBINATORIAL MATHEMATICS (4-0).
Advanced techniques in the computational counting process. Enumerative algorithms are analyzed. The systematic analysis of different possibilities, the exploration of logical structure and the application of intuitive insight are stressed. Numerical examples to display these concepts are developed. PREREQUISITE: MA3026.

MA4027 GRAPH THEORY AND APPLICATIONS (4-0).
Advanced topics in graph theory with an emphasis on communication networks, flows, phasing of signals and scheduling. Students learn to implement new graph theory techniques in their area of study. Further models in such areas as energy use and air flow will be examined, in addition to the core material. PREREQUISITE: MA3026 or consent of instructor.

MA4101 INCREMENTED DIRECTED STUDY (1-0).
Provides the opportunity for the student enrolled in a 4000-level mathematics course to pursue the subject under faculty supervision to greater depth. One extra credit is assigned beyond the normal course credit. PREREQUISITES: Enrollment in a 4000 level math course and consent of instructor.

MA4102 INCREMENTED DIRECTED STUDY (2-0).
Provides the opportunity for the student enrolled in a 4000-level mathematics course to pursue the subject under faculty supervision to a greater depth. Two extra credits are assigned beyond the normal course credit. PREREQUISITES: Enrollment in a 4000-level math course and consent of instructor.

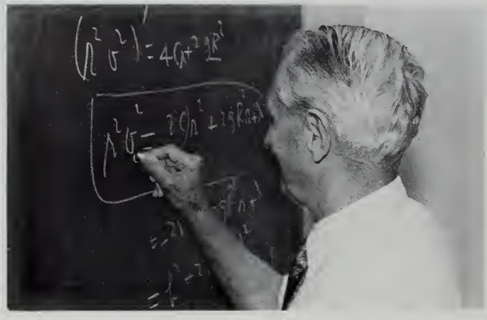
MA4103 THESIS TOPICS SEMINAR (3-0).
Explores in depth the thesis topics of students enrolled in the mathematics degree program. PREREQUISITE: Consent of instructor. Graded on Pass/Fail basis only.

MA4237 ADVANCED TOPICS IN NUMERICAL ANALYSIS (Variable credit, usually 4-0) (V-0).
The subject matter will vary according to the abilities and interests of those enrolled. PREREQUISITE: Consent of instructor.

MA4311 CALCULUS OF VARIATIONS (3-0).
Euler equation, Weierstrass maximum principle. Legendre condition, numerical procedures for determining solutions, gradient methods, Newton's method, tranversality condition. Rayleigh-Ritz method, conjugate points and applications. PREREQUISITE: MA2121 (programming experience desirable).

MA4312 TOPICS IN CALCULUS OF VARIATIONS (3-0).
Recent development of the numerical solution of problems in the calculus of variations. Foundations of numerical methods, applications to control problems. Differentials, pertubations, variational equations, adjoint systems, conditions for optimum. Euler equations, maximum principle of Weierstrass and Pontryagin, the Legendre condition. Methods of solution: special variations, variation of extremals, dynamic programming. Applications in ship routing and missile control. PREREQUISITES: MA2121 and computer programming or consent of instructor.

MA4322 PRINCIPLES AND TECHNIQUES OF APPLIED MATHEMATICS I (3-0).
Linear operators, generalized functions and Hilbert spaces; solutions of partial differential equations by Green's functions and eigenfunctions; variational techniques and their applications to eigenfunctions; Fredholm and Volterra integral equations; asymptotic methods and perturbations. PREREQUISITE: MA3132 or equivalent.



MA4323 PRINCIPLES AND TECHNIQUES OF APPLIED MATHEMATICS II (3-0).
Continuation of MA4322. PREREQUISITE: MA4322.

MA4362 ORBITAL MECHANICS (3-0).
A review of the two body problem; non central geopotentials; long-term periodic effects; perturbations. PREREQUISITE: Consent of Instructor.

MA4372 INTEGRAL TRANSFORMS (3-0).
The Laplace, Fourier and Hankel transforms and their inversions; Asymptotic behavior. Applications to problems in engineering and physics. PREREQUISITE: Consent of instructor.

MA4391 ANALYTICAL METHODS FOR FLUID DYNAMICS (4-0).
The basic fluid dynamic equations will be derived and a variety of analytical methods will be applied to problems in viscous flow, potential flow, boundary layers and turbulence. PREREQUISITE: MA3132 or MA3139 or consent of instructor.

MA4392 NUMERICAL METHODS FOR FLUID DYNAMICS (4-0).
Numerical methods exclusively will be applied to fluid dynamics problems in viscous flow, potential flow, boundary layers and turbulence. PREREQUISITES: MA4391 and MA3232 or consent of instructor.

MA4393 TOPICS IN APPLIED MATHEMATICS (3-0).
A selection of topics in applied mathematics. The course content varies. Credit may be granted for taking this course more than once. PREREQUISITE: Consent of instructor.

MA4560 CODING AND INFORMATION THEORY (4-0).
Mathematical analysis of the codes used over communication channels is made. Techniques developed for efficient, reliable and secure communication are stressed. Effects of noise on information transmission are analyzed and techniques to combat their effects are developed. Linear codes, finite fields, single and multiple error correcting codes are discussed. PREREQUISITE: MA3560.

MA4565 MODERN ADVANCED ALGEBRA (3-0).
A continuation of MA3565. Rings, ring homomorphism, integral domains and euclidean domains. Unique factorization rings, polynomial rings. Modules and ideals. Noetherian rings, Field extension and Galois theory. PREREQUISITE: MA3565, or consent of instructor.

MA4570 CRYPTOGRAPHY (4-0).
The methods of secret communication are addressed. Some simple cryptosystems are described and classical techniques of substitution and transposition are considered. The public-key cryptosystems, RSA, Discrete Logarithm and other schemes are introduced. PREREQUISITE: MA3560.

MA4593 TOPICS IN ALGEBRA (3-0).
A selection of topics in algebra. Content of the course varies. Students will be allowed credit for taking the course more than once. PREREQUISITE: Consent of instructor.

MA4595 MATHEMATICAL FOUNDATIONS OF FAST SIGNAL PROCESSING ALGORITHMS (3-0).
Advanced transform algorithms for signal processing and their inversions, including the interactions between hardware and algorithm design. Block Matrix Factorization, the generalized Cooley-Tukey and Rader prime factor algorithms. The Chinese Remainder Theorem and Second Integer Representation for integers and Winograd FFT algorithms. Polynomial rings, the Chinese Remainder theorem for polynomials and reduced multiplication convolution algorithms. Quotient Fields and the Fermat and Mersenne Number Theoretic Transforms. PREREQUISITE: EC3400 or equivalent.

MA4620 THEORY OF ORDINARY DIFFERENTIAL EQUATIONS (3-0).
Introduction to the modern theory of ordinary differential equations. Systems of equations. Theoretical and constructive methods of solutions. PREREQUISITE: Consent of instructor.

MA4635 FUNCTIONS OF REAL VARIABLES I (3-0).
Semi-continuous functions, absolutely continuous functions, functions of bounded variation; classical Lebesque measure and integration theory, convergence theorems and Lp spaces. Abstract measure and integration theory, signed measures, Radon-Nikodym theorem; Lebesque decomposition and product measure; Daniell integrals and integral representation of linear functionals. PREREQUISITE: MA3606.

MA4636 FUNCTIONS OF REAL VARIABLES II (3-0).
Continuation of MA4635. PREREQUISITE: MA4635.

MA4693 TOPICS IN ANALYSIS (3-0).
A selection of topics in analysis. Content of the course varies. Students will be allowed credit for taking the course more than once. PREREQUISITE: Consent of instructor.

DEPARTMENT OF MECHANICAL ENGINEERING

Chairman:
Anthony J. Healey,
Professor,
Code ME/Hy, Halligan Hall,
Room M-4,
(408) 646-2586/3462,
AV 878-2536/3462.

Associate Chairman:
Matthew D. Kelleher,
Professor,
Code ME/Kk, Halligan Hall,
Room 209,
(408) 646-2530,
AV 878-2530.

Liang-Wey Chang, Assistant Professor (1985)*; PhD, Purdue University, 1984.

Roy Crooks, Adjunct Teaching Professor (1990); PhD, Georgia Institute of Technology, 1982.

Indranath Dutta, Assistant Professor (1988); PhD, University of Texas, Austin, 1988.

Alan Fox, Associate Professor (1989); PhD, University of Birmingham, United Kingdom, 1987.

Thomas L. Geers, ONT Chair Professor (1990); PhD, Massachusetts Institute of Technology, 1967.

James F. Hallock, Adjunct Teaching Professor (1989); MS, Massachusetts Institute of Technology, 1965.

Anthony Healey, Chairman and Professor (1986); PhD, Sheffield University, United Kingdom, 1966.

Yogendra Joshi, Associate Professor (1986); PhD, University of Pennsylvania, 1984.

Peter Kalu, Adjunct Research Professor (1989); PhD, Imperial College, London University, 1986.

Matthew Dennis Kelleher, Professor (1967); PhD, University of Notre Dame, 1966.

Dong Soo Kim, Adjunct Teaching Professor (1989); PhD, University of California at Santa Barbara, 1989.

Young W. Kwon, Assistant Professor (1990); PhD, Rice University, 1985.

Shankar Lal, Adjunct Professor (1985); PhD, California Institute of Technology, Pasadena, 1955.

Phillip Meredith Ligrani, Associate Professor (1984); PhD, Stanford University, 1980.

Paul James Marto, Dean of Research Distinguished Professor (1965); ScD, Massachusetts Institute of Technology, 1965.

Terry Robert McNelley, Professor (1976); PhD, Stanford University 1973.

Steven Memory, Adjunct Teaching Professor (1990); PhD, London University, 1990.

Fotis A. Papoulias, Adjunct Professor (1988); PhD, University of Michigan, 1987.

Arthur Jeffrey Perkins, Professor (1972); PhD, Case Western Reserve University, 1969.

Paul Francis Pucci, Professor (1956); PhD, Stanford University, 1955.

avid Salinas, Associate Professor (1970); PhD, University of alifornia, Los Angeles, 1968.

urgut Sarpkaya, Distinguished Professor (1967); PhD, University f Iowa, 1954.

hillip Yungseok Shin, Assistant Professor (1988); PhD, VA olytechnic Institute and State University, 1988.

oung Sik Shin, Professor (1981); PhD, Case Western Reserve niversity, 1971.

helakara S. Subramanian, Adjunct Research Professor (1988); hD, University of Newcastle, United Kingdom, 1981.

anjeev Sathe, Adjunct Research Professor (1989); PhD, Arizona tate University, 1989.

The year of joining the Naval Postgraduate School faculty is indicated in arentheses.

he department of Mechanical Engineering provides a strong cademic program which spans across the discipline areas of tructural mechanics, dynamics and ontrol, materials science and the hermal-fluid sciences. These isciplines are blended together with n emphasis on naval engineering pplications such as may be xperienced on surface vessels and in ubmarines.

rograms leading to the degree aster of Science in Mechanical ngineering are accredited at the dvanced level by the Engineering ccreditation Commission of the ccreditation Board for Engineering nd Technology.

specific curriculum must be onsistent with the general minimum equirements for the degree as etermined by the Academic Council.

ny program leading to award of a egree must be approved by the hairman of the Department of echanical Engineering at least two uarters before completion. In general, approved programs will equire more than minimum degree requirements in order to conform the needs and objectives of the United States Navy.

ASTER OF SCIENCE IN MECHANICAL ENGINEERING

candidate shall have completed work equivalent to the Bachelor of cience requirements of this department. Candidates who have not ajored in Mechanical Engineering, or who have experienced a ignificant lapse in continuity with previous academic work, initially will take undergraduate courses in mechanical engineering and mathematics in preparation for their graduate program.

The candidate must take all courses in a curriculum approved by the Chairman of the Department of Mechanical Engineering. At minimum the approved curriculum must satisfy the requirements below.

The Master of Science degree in Mechanical Engineering requires at least 32-quarter hours of graduate level credits in Mechanical Engineering and Materials Science, at least 12 of which must be at th 4000 level. In addition, at least 8-quarter hours of graduate credit must be earned outside of Mechanical Engineering and Materials Science.

An acceptable thesis is required for the Master of Science in Mechanical Engineering degree. An acceptable thesis for the degree Mechanical Engineer may also be accepted as meeting the thesis requirement for the master's degree. Approval of the thesis advisor and topic must be obtained from the Chairman of the Department of Mechanical Engineering.

MASTER OF SCIENCE IN ENGINEERING SCIENCE

Students with acceptable academic backgrounds may enter a program leading to the degree Master of Science in Engineering Science (with major in Mechanical Engineering).

The program must include at least 36-credit hours of graduate work i the disciplines of engineering, science and mathematics, 12 of which must be at the 4000 level. Of these 36 hours, at least 20 hours (8 of which must be at the 4000 level) must be in Mechanical Engineering and Materials Science.

In addition, the program must contain at least 12 hours at the graduate level in courses outside Mechanical Engineering and Materials Science.

The student seeking the degree Master of Science in Engineering Science must submit an acceptable thesis. Programs leading to this degree must be approved by the Chairman of the Department of Mechanical Engineering.

MECHANICAL ENGINEER

A graduate student with a superior academic record may enter a program leading to the degree Mechanical Engineer. A candidate is normally selected after completion of his firs year of residence.

A candidate must take all courses in a curriculum approved by the Chairman of the Department of Mechanical Engineering. At minimum, the approved curriculum must satisfy the requirements stated in the following paragraphs.

he Mechanical Engineer degree requires at least 60-quarter hours of raduate-level credits in Mechanical Engineering and Materials cience, at least 30 of which must be at the 4000 vel. In addition, at least 12-quarter hours of raduate-level credits must be earned outside of echanical Engineering and Materials Science.

n acceptable thesis is required for the echanical Engineer degree. Approval of the esis advisor and program must be obtained om the Chairman of the Department of echanical Engineering.

OCTOR OF PHILOSOPHY AND DOCTOR F ENGINEERING

he Department of Mechanical Engineering has n active program leading to the degrees of octor of Philosophy and Doctor of Engineering. reas of special strength in the department are ydrodynamics, viscous flows, heat transfer, aterials science, dynamics and control, ibrations and finite element analysis and mputer aided design.

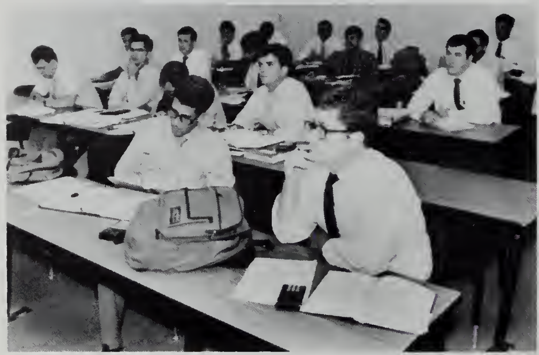
ntrance into the doctoral program may be equested by officers currently enrolled who ave sufficiently high standing. A departmental reening examination will be administered to ose so requesting. The department also ccepts officer students selected in the Navy-wide doctoral study rogram and civilian students selected from employees of the United tates Federal Government.

ll applicants who are not already enrolled as students in the epartment of Mechanical Engineering shall submit transcripts of eir previous academic and professional records and letters of ecommendation to the department Chairman. The Chairman, with e advice of other department members, shall decide whether or not admit the applicant to the doctoral program.

very applicant who is accepted for the doctoral program will initially enrolled in the Mechanical Engineering Program under a special ption which satisfies the broad departmental requirements for the ngineer's degree and which includes research work. As soon as asible, the student must find a faculty advisor to supervise his search and help him initially in the formulation of his plans for dvanced study. As early as practicable thereafter, a doctoral mmittee shall be appointed to oversee that student's individual ctoral program as provided in the school-wide requirements for the ctor's degree.

int programs with other departments are possible. A noteworthy ature of the program leading to the Doctor of Engineering degree is at the student's research may be conducted away from the Naval ostgraduate School in a cooperating laboratory or other installations the Federal Government. The degree requirements are as outlined the general school requirements for the doctor's degree.

LABORATORIES



The Mechanical Engineering Laboratories are designed as complements to the educational mission and research interests of the department. In addition to extensive facilities for the support of student and faculty research, a variety of general use equipment is available. This includes machinery for the investigation of dynamic and statistics problems in engineering mechanics; a completely equipped materials science laboratory, including a scanning electron microscope, a transmission electron microscope and an X-ray diffractometer; an oscillating water tunnel, a unique underwater towing tank and a low turbulence water channel; a vibration analysis laboratory; a fluid power controls laboratory; a robotics and real-time control laboratory; facilities for experimentation with low velocity air flows; equipment for instruction in thermal transport phenomena; a laser doppler velocimeter; nuclear radiation detection equipment and an interactive CAD/CAE computer graphics laboratory. Experimentation is further enhanced by a broad selection of analog and digital data acquisition and processing equipment and instrumentation.

COURSE OFFERINGS

ME0810 THESIS RESEARCH (0-0).

Every student conducting thesis research will enroll in this course.

ME0951 SEMINARS (NO CREDIT) (0-1).

Lectures on subjects of current interest are presented by NPS faculty and invited experts from other universities and government and industrial activities.

ME1000 PREPARATION FOR PROFESSIONAL ENGINEERS REGISTRATION (3-0).

The course will cover the topics from the 8-hour Professional Examination given by the State of California for Professional Engineer. Discussion will involve applicable engineering techniques, including design and analysis of mechanical systems and components. PREREQUISITE: Prior passage of EIT Exam or consent of instructor. Graded on Pass/Fail basis only.

ME2001 INTRODUCTION TO ENGINEERING (3-0).

The origins of engineering. The role of mathematics and the physical sciences in engineering. Definition of an engineering problem, including its formulation, assumptions and method of attack. Engineering analysis. The engineering design process. Engineering communications, including graphics. This course is intended for students with a non-engineering background. PREREQUISITE: MA1117 (may be taken concurrently).

ME2101 ENGINEERING THERMODYNAMICS (4-1).

A comprehensive coverage of the fundamental concepts of classical thermodynamics, with insight toward microscopic phenomena. The aws of thermodynamics. Equations of state. Thermodynamic properties of substances. Entropy, irreversibility and availability. Cycle analysis. Gas-vapor mixtures. Combustion and dissociation. PREREQUISITE: MA1118.

ME2201 INTRODUCTION TO FLUID MECHANICS (3-2).

Properties of fluids, hydrostatics and stability of floating and submerged bodies. Fluid flow concepts and basic equations in steady flows: mass, momentum and energy considerations. Dimensional analysis and dynamic similitude. Viscous effects and fluid resistance. Drag and separated flow over simple bluff bodies. PREREQUISITE: ME2502.

ME2301 INTRODUCTION TO NAVAL ARCHITECTURE (3-1).

Introduction to the hydrostatics and hydrodynamics of a monohull vessel. Hull structural strength using simple approximations and common ship building materials. Intact initial transverse and longitudinal stability. Stability at large angles of heel and under special circumstances such as docking and after damage to the hull. Resistance and powering of the hull; determination of effective horsepower. PREREQUISITES: ME2201 and ME2601.

ME2440 THE DIGITAL COMPUTER AS AN ENGINEERING TOOL (3-0).

Introduction to high-level programming languages including FORTRAN and BASIC. Development of computer programs, subroutine organization, input and output. Application of programming techniques to the solution of selected problems in Mechanical Engineering. PREREQUISITES: MA1118, ME2101, ME2501 (all may be taken concurrently), ME2441 (must be taken concurrently).

ME2441 ENGINEERING COMPUTATIONAL LABORATORY (0-2).

Introduction to the computing facilities at the Naval Postgraduate School with particular emphasis on those unique to the Department of Mechanical Engineering. Familiarization with software available at the Naval Postgraduate School for solution of engineering problems. Various programming exercises. (ME 2440 must be taken concurrently). Graded on a Pass/Fail basis only.

ME2501 STATICS (3-0).

Forces and moments, particles and rigid bodies in equilibrium. Simple structures, friction, first moments and centroids. PREREQUISITE: MA1118 (may be concurrent).

ME2502 DYNAMICS (4-1).

Kinematics and kinetics of particles and rigid bodies. Rectilinear, plane curvilinear and space curvilinear motion. Newton's laws, work and energy, impulse and momentum and impact. Plane motion of rigid bodies and introduction to gyroscopic motion. PREREQUISITE: ME2501.

ME2601 MECHANICS OF SOLIDS I (3-2).

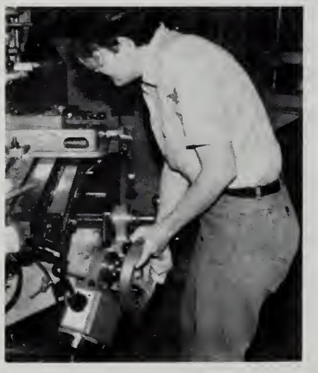
Stress-strain. Hookes Law. Plane stress and plane strain. Stress transformation for plane stress. Mohr's circle. Principal stresses and axes. Stress analysis of bars, circular shafts, cylindrical and spherica thin walled pressure vessels. Shear and bending diagrams for beams. Stresses in beams. Failure theories. Torsion of thin walled closed tubes. Composite beams. Euler columns. Supporting laboratory work. PREREQUISITES: ME2501 and MA1118 or equivalent.

ME2801 INTRODUCTION TO ENGINEERING SYSTEM DYNAMICS (3-2).

Generalized system modeling principles and reduction to mathematical forms. Analogies between electrical, mechanical, fluid and thermal systems. Response of first and second order systems characteristics, transient response. PREREQUISITES: ME2502 and MA2121.

ME3150 HEAT TRANSFER (4-2).

Elementary treatment of the principles of heat transfer, application to problems in Mechanical Engineering. Steady and unsteady conduction. Principles of forced and natural convection. Thermal radiation. Boiling. Condensation. Heat exchanger analysis. Use of the thermal circuit analog, numerical and graphical techniques. Selected laboratory experiments. PREREQUISITES: ME2101, ME2201, MA3132 (may be taken concurrently).



ME3201 INTERMEDIATE FLUID MECHANICS (3-2).

Steady one-dimensional compressible flow. Fundamentals of ideal-fluid flow, potential function, stream function. Analysis of viscous flows, velocity distribution in laminar and turbulent flows, introduction to the elements of the Navier-Stokes equations, solution of classical viscous laminar flow problems. Boundary layer concepts. PREREQUISITES: ME2101, ME2201, MA3132 (may be taken concurrently).

ME3220 STEAM POWER, REFRIGERATION and TURBOMACHINERY (3-2).

The conventional Rankine cycle steam plants, including superheat, reheat and regenerative cycles. Boiler, condenser and feed-water heater description. Thermodynamics of refrigeration systems. Fundamentals of turbomachinery: energy and momentum equations, dimensional analysis and velocity diagrams. Blade design and work determination from blade shape. Application to pumps, fans, compressors and turbines. PREREQUISITES: ME2101 and ME2201.

ME3230 NUCLEAR POWER SYSTEMS (3-1).

Introduction to atomic and nuclear physics. Fundamentals of nuclear reactor analysis, including nuclear and thermal aspects in core design. Reactor system design and operation. Comparison of principal reactor types emphasizing significant features of marine reactors. Basic health physics considerations and reactor shielding. Basic insight into waste management and reactor safety. PREREQUISITE: MA3132.

ME3240 RECIPROCATING AND GAS TURBINE POWER PLANTS (3-0).
Thermodynamic analyses and performance characteristics of single and multi-stage reciprocating air compressors, spark ignition engines (Otto Cycle), compression ignition engines (diesel cycle) and gas turbine engines (Brayton cycle). Gas turbine component characteristics including the aerodynamics of the compressor and turbine design and the combuster. Ship propulsion requirements, propeller characteristics and Ship/Propeller/Power Plant matching. PREREQUISITES: ME2101, ME2201, (ME3241 must be taken concurrently).

ME3241 POWER PLANTS LABORATORY (0-3).
Selected experiments demonstrating power plant performance, e.g., diesel engine and gas turbine engine. (ME 3240 must be taken concurrently.) Graded on Pass/Fail basis only.

ME3410 MECHANICAL ENGINEERING INSTRUMENTATION AND MEASUREMENT LAB (2-4).
Introduction to measurement systems, statistical analysis of data, error analysis, uncertainty analysis, manipulation of data including electrical readout and processing, data acquisition fundamentals. Measurement of temperature, pressure, velocity, flow rates. Energy balances, surface temperature visualization, flow visualization. Measurement of motion using accelerometers and encoders. Measurement of strain and force. Operational amplifiers, analog computers, filters. PREREQUISITES: ME2601, ME2801, ME3521, ME3150 (ME3150 and ME3521 may be taken concurrently).

ME3440 ENGINEERING ANALYSIS (4-0).
Rigorous formulation of engineering problems arising in a variety of disciplines. Approximate methods of solution. Finite Difference methods. Introduction to finite Element methods. PREREQUISITES: ME2201, ME2440, ME2502 and ME2601.

ME3521 MECHANICAL VIBRATION (3-2).
Free and forced vibration of discrete linear systems. Vibration isolation and suppression. Vibration of bars, shafts and beams. Supporting laboratory work. PREREQUISITES: ME2502, ME2601 and MA2401 or equivalent (may be taken concurrently).

ME3611 MECHANICS OF SOLIDS II (4-0).
Differential equations of bars, shafts and beams with Macauley functions Unsymmetric bending. Curved beams. Shear flow in thin walled sections. Shear center. Torsion of thin walled open sections. Thick walled cylinders. Energy including Castigliano and unit dummy load methods for displacements. Statically indeterminate systems including beams, frames, trusses, arches and combined structures. PREREQUISITE: MA2047 or MA2089

ME3711 DESIGN OF MACHINE ELEMENTS (4-1).
Design of representative machine elements with consideration given to materials selection, tolerances, stress concentrations, fatigue, factors of safety, reliability and maintainability. Typical elements to be designed include fastener, columns, shafts, journal bearings, spur and helical gears and clutches and brakes. In addition to traditional design using factors of safety against failure, particular emphasis is placed on design for specified reliability using probabilistic design methods. PREREQUISITE: ME2601.

ME3801 LINEAR AUTOMATIC CONTROL (3-0).
Classical control design for linear systems with single input, single output design requirements. PID control. Transient response analysis. Root locus and frequency response methods. Control design and compensation techniques. PREREQUISITE: ME2801. ME3802 must be taken concurrently.

ME3802 CONTROLS LABORATORY (0-2).
Adjunct laboratory for ME3801. Must be taken concurrently with ME3801.

ME3950 SURFACE SHIP SURVIVABILITY (4-0).
Surface ship survivability requirements and lessons learned in combat; radar cross section reduction by shaping and RAM; IR missile detection and tracking; electronic counter measures for decoying and jamming missiles. Assessment of ship survivability and implementation of trade-off studies. Case study of DDG-51 survivability design. PREREQUISITES: Consent of instructor and department Chairman.

ME4160 APPLICATIONS OF HEAT TRANSFER (4-0).
Applications of heat transfer principles to engineering systems. Topics include heat exchangers (e.g., boilers, condensers, coolers), cooling electronic components, heat pipes, solar collectors, turbine blade cooling. PREREQUISITE: ME3150.

ME4161 CONDUCTION HEAT TRANSFER (4-0).
Steady-state heat conduction in multi-dimensions with and without heat sources. Transient conduction. Numerical methods for heat conduction. Mechanical Engineering applications. PREREQUISITE: ME3150.

ME4162 CONVECTION HEAT TRANSFER (4-0).
Fundamental principles of forced and free convection. Laminar and turbulent duct flows and external flows. Dimensionless correlations. Heat transfer during phase changes. Heat exchanger analysis with Mechanical Engineering applications. PREREQUISITES: ME3150, ME4220.

ME4163 RADIATION HEAT TRANSFER (3-0).
Basic laws and definitions. Radiation properties of surfaces. Radiant interchange among diffusely emitting and reflecting surfaces. Applications and solutions of the equations of radiant interchange. Radiant interchange through participating media. Combined conduction and radiation. PREREQUISITE: ME3150.

ME4202 COMPRESSIBLE FLOW (3-0).
Review of simple one-dimensional flow. Generalized one-dimensional flow. Two-dimensional and axisymmetric flows. Subsonic flow with small perturbations. Mach lines. Methods of characteristics. Prandtl-Meyer expansion waves. Oblique shocks. Unsteady, one-dimensional flow. Introduction to compressible boundary layer. PREREQUISITE: ME3201 or equivalent compressible flow coverage.

ME4211 APPLIED HYDRODYNAMICS (4-0).
Fundamental principles of hydrodynamics. Brief review of the equations of motion and types of fluid motion. Standard potential flows: source, sink, doublet and vortex motion. Flow about two-dimensional bodies. Flow about axisymmetric bodies. Added mass of various bodies and the added-mass moment of inertia. Complex variables approach to flow about two-dimensional bodies. Conformal transformations. Flow about hydro and aerofoils. Special topics such as dynamic response of submerged bodies, hydroelastic oscillations, etc. Course emphasizes the use of various numerical techniques and the relationship between the predictions of hydrodynamics and viscous flow methods. PREREQUISITE: ME3201.

ME4220 VISCOUS FLOW (4-0).
Development of continuity and Navier-Stokes equations. Exact solutions of steady and unsteady viscous flow problems. Development of the boundary-layer equations. Similarity variables, numerical and integral techniques. Separation, boundary-layer control, compressibility effects. Time-dependent boundary layers. Origin and nature of turbulence, phenomenological theories, calculation of turbulent flows with emphasis on naval engineering applications. PREREQUISITE: ME3201.

ME4240 ADVANCED TOPICS IN FLUID DYNAMICS (4-0).
Topics selected in accordance with the current interests of the students and faculty. Examples include fluid-structure interactions, cable strumming, wave forces on structures, free-streamline analysis of jets, wakes and cavities. PREREQUISITES: ME4220 and ME4211.

ME4420 MARINE GAS TURBINES (4-0).
Thermodynamic analyses of gas turbine cycles, including airbreathing and closed cycle engines. Internal aerodynamics of compressor and turbine design. Combustor and source heat exchanger design. Materials considerations. Operational controls and instrumentation. Lubrication and fuels systems. Inlet, exhaust and silencing systems. Propulsion of surface effect, hydrofoil and conventional surface ships. Installation arrangements. Waste heat recovery systems and combined cycles (COGAS, CODOG). Auxiliary power generation. Repair and maintenance. PREREQUISITE: ME3240.

ME4522 SHIPBOARD VIBRATION AND NOISE (4-0).
Mechanical impedance, transfer matrices and their application to transmission of vibratory motion from machinery sources to hull plating. Acoustic signal generation at the hull-fluid interface. Characteristics of viscoelastic materials and their use in vibration isolation. Multi-isolator mounts. Study of accordian and flexural vibration of ship hulls using one-dimensional finite element modeling. Military vibration specifications. Use of Vibration measurements for machinery condition monitoring. PREREQUISITE: ME3521.

ME4525 NAVAL SHIP SHOCK DESIGN AND ANALYSIS (4-0).
Characteristics of underwater explosion phenomena, including the shock wave, bubble behavior and bubble pulse loading and bulk cavitation. Surface ship/submarine bodily response to shock loading. Application of shock spectra to component design. Dynamic Design Analysis Method (DDAM) and applications to shipboard equipment design. Fluid-Structure Interaction (FSI) analysis, including Doubly Asymptotic Approximation (DAA) and surface ship FSI. Current design requirements for shipboard equipment. PREREQUISITE: ME3521 or equivalent.

ME4550 RANDOM VIBRATIONS AND SPECTRAL ANALYSIS (3-2).
Engineering application of spectral analysis techniques to characterize system responses under a random vibration environment. Characteristics of physical random data and physical system responses. Application of probability concepts to random data and response analysis. Correlation and spectral density functions. Transmission of random vibration. System responses to single/multiple random excitations. Failure due to random vibration. Supporting laboratory work. PREREQUISITE: ME3521 or equivalent.

ME4612 ADVANCED MECHANICS OF SOLIDS (4-0).
Selected topics from advanced strength of materials, elasticity and the theory of plates and shells. Applications of finite element codes to the solution of difficult problems. PREREQUISITE: ME3611.

ME4613 FINITE ELEMENT METHODS (4-0).
Systematic construction of line, surface and volume elements for continuous systems. Computer programming and applications to structural mechanics, heat transfer and fluid flow. PREREQUISITE: ME3611.

ME4620 THEORY OF CONTINUOUS MEDIA (4-0).
Tensor analysis. Stress and strain tensors. Motion of continuum. Energy and entropy. Constitutive equations. Applications to elasticity and fluid dynamics. PREREQUISITES: ME3201 and ME3611.

ME4721 MARINE VEHICLE DESIGN (2-4).
Various categories of marine vehicles are described; this includes single hull, multiple hull, submarine, surface effect, wing-in-ground effect and hydrofoil vehicles. A category of marine vehicle is selected to fulfill a stated mission. A vehicle configuration and specification of major facets of marine vehicle synthesis including structures, hull forces, propulsion, electronics, armament, crew, etc. PREREQUISITE: Consent of instructor.

ME4722 MARINE ENGINEERING DESIGN (2-4).
A major component of a marine vehicle is designed so as to meet stated specifications. Impact of the design features of the major component upon the overall vehicle performance is considered; emphasis is on design tradeoffs. Examples of major components to be designed include complete electrical power generation and distribution systems, steering, superconducting electrical motors for main propulsion, bulbous bow for sonar, armor protection of CIC, etc. PREREQUISITE: Consent of instructor.

ME4731 ENGINEERING DESIGN OPTIMIZATION (4-0).
Application of automated numerical optimization techniques to design of engineering systems. Algorithms for solution of nonlinear constrained design problems. Familiarization with available design optimization programs. State-of-the-art applications. Solution of a variety of design problems in mechanical engineering, using numerical optimization techniques. PREREQUISITES: ME3150, ME3201, ME3611, ME2440, MA2400, or equivalent.

ME4811 MODERN CONTROL SYSTEMS (3-2).
Multivariable analysis and control concepts for MIMO systems. State Observers. Linear Optimal Control. Introduction to non-linear systems analysis. Limit cycle behavior. PREREQUISITE: ME3801.

ME4812 FLUID POWER CONTROL (3-0).
Fluids and fluid flows in high-performance actuators and controllers. Power flow and fluid power elements - valve and pump control, linear and rotary motion. State space descriptions. Design of electro-hydraulic position and velocity control servo-mechanisms for high performance with stability. ME4813 must be taken concurrently. PREREQUISITE: ME3801.

ME4813 FLUID POWER LABORATORY (0-2).
Adjunct laboratory course for ME4812. Must be taken concurrently with ME4812.

ME4821 ADVANCED DYNAMICS (3-2).
Introduction to the variational principle. Kinematics and dynamics of three-dimensional motion for complex systems utilizing Newton-Euler's method, Lagrange's method and Kane's method. Computer software implementation and simulation. Applications in robotics emphasizing the dynamic problems of design and control. PREREQUISITE: ME3521.

ME4823 DYNAMICS OF MARINE VEHICLES (4-0).
Development of the nonlinear equations of motion in ship-fixed coordinates. Linear forms. Elements of pathkeeping and stability for ships and submersibles. Maneuverability. Hydrodynamic aspects of hull propulsor and appurtenances. Design tools for estimating hydrodynamic derivatives and their effects on vehicle performance. Selected topics. PREREQUISITE: ME3201.

ME4825 MARINE PROPULSION CONTROL (3-2).
Introduction to dynamic propulsion systems modeling and analysis methods. Control design specifications and design strategies. Introduction to modern control design theory and multivariable methods. Theory and applications of optimal control and discrete-time control systems. Case studies of current Naval propulsion control systems. PREREQUISITES: ME3801, ME3240 (may be taken concurrently) and MA3132.

ME4902 ADVANCED STUDY IN MECHANICAL ENGINEERING (Variable hours 1-0 to 6-0) (V-0).
Directed advanced study in mechanical engineering on a subject of mutual interest to student and staff member after most of a student's electives have already been taken. May be repeated for credit with a different topic. PREREQUISITE: Permission of department Chairman. Graded on Pass/Fail basis only.

MS0810 THESIS RESEARCH (0-0).
Every student conducting thesis research will enroll in this course.

MS2201 ENGINEERING MATERIALS (3-2).
The basic principles of materials science are covered with emphasis on the factors involved in control of the strength and ductility of metallic materials of Naval interest. Atomic and crystal structure are discussed and emphasis is given to microstructural control and microstructure-property relationships. Additional topics include crystalline defects, deformation processes, strengthening mechanisms and heat treatment. The course aims to provide the student with the working vocabulary and conceptual understanding necessary to more advanced study and for communication with materials experts. PREREQUISITES: Undergraduate courses in physics and chemistry and consent of instructor.

MS3201 MATERIALS SCIENCE AND ENGINEERING (3-2).
Fundamental principles of materials science are presented with particular emphasis on and advanced coverage of the relationship between microstructure and mechanical properties of engineering materials. The effects of atomic structure, crystal structure and microstructure on properties are presented. Crystalline defects, deformation processes, strengthening mechanisms, fracture, phase equilibria, phase transformations and methods of microstructural control are discussed and practical examples are included. The course aims at providing the engineering student with the vocabulary and conceptual understanding necessary for further study and for communicating on materials engineering topics. PREREQUISITE: Undergraduate course in chemistry and physics.

MS3202 FAILURE ANALYSIS AND PREVENTION (3-2).
Properties, problems and failures of structural materials are studied in the context of actual case studies. Topics of interest to Naval, Aero and Weapons engineers are included. For a given case study, the cause(s) of failure are discussed and the relevant fundamental knowledge to fully understand the observed phenomena is developed. Failure prevention, materials developments and modern methods of materials analysis are among the many aspects that are of interest. PREREQUISITE: MS3201 or equivalent or consent of instructor.

MS3304 CORROSION AND MARINE ENVIRONMENTAL DEGRADATION (3-2).
Presents the basic chemical, electrochemical, mechanical and metallurgical factors which influence the corrosion, oxidation and deterioration of materials. Discusses standard methods of corrosion control, such as cathodic protection coatings, cladding, alloy selection and inhibitors; special problems encountered in unfamiliar environment. PREREQUISITE: MS2201 or equivalent.

MS3401 MICROSCOPY (3-2).

Electron microscopy and other sophisticated techniques are emphasized in a coverage of modern methods of microscopic observation. Techniques covered include scanning electron microscopy, transmission electron microscopy, conventional microprobe analysis, field ion microscopy and polarized light, stereo, interference, phase contrast and holographic light optical methods. Course and lab will simultaneously cover both theory and practice, including specimen preparation, instrument design and operation and applications. PREREQUISITE: Consent of instructor.

MS3505 MATERIALS SELECTION FOR MILITARY APPLICATIONS (4-0).

This course deals in depth with one of the most common and important problems in materials engineering, that of selecting the optimum material for a given application. Consideration is also given to evolution of new applications for existing materials and to materials development for new and old applications. A variety of application areas are covered, including marine structures, aerospace applications, nuclear reactors, electronics, high temperature cryogenic services and many other situations. Sources of information, methodology and basic rationale for materials selection decisions are presented. Emphasis is put on the variation in properties of a given material with processing history and on variation of properties in service. PREREQUISITE: MS2201 or equivalent.

MS3606 INTRODUCTION TO WELDING AND JOINING METALLURGY (3-2).

Welding and joining are presented from the point of view of metallurgy. Topics include the nature and applications of welding and joining processes; the welding thermal cycle; metallurgical effects of the welding thermal cycle; welding and joining of steels, aluminum alloys, stainless steels and heat resistant alloys. Also, weldment inspection and quality assurance are introduced. PREREQUISITE: MS2201/MS3201.

MS4215 PHASE TRANSFORMATIONS (3-2).

Structural changes which commonly occur in materials by various mechanisms are considered. Solidification, precipitation, recrystallization and martensitic transformations are emphasized, both in principle and in regard to their technological importance. Principles of nucleation and growth, diffusion and kinetics are presented and their relevance to practical heat treating and fabrication processes are considered. PREREQUISITE: MS2201 or equivalent.

MS4302 SPECIAL TOPICS IN MATERIALS SCIENCE (Variable hours 1-0 to 6-0) (V-0).

Directed advanced study in materials science on a subject of mutual interest to student and staff member after the student has taken most of his or her electives. May be repeated for credit with a different topic. PREREQUISITE: Permission of department Chairman. Graded on Pass/Fail basis only.

MS4312 ADVANCED MATERIALS (4-0).
The course is structured to provide a vehicle for the study of materials pertinent to a specific area of environment utilization or design. Example categories are marine materials, elevated-temperature materials, aircraft alloy materials for energy conversion. Topics discussed may include material failures, materials selection testing and new concepts in materials engineering. Course scope is decided by mutual agreement of students and instructor. PREREQUISITES: MS2201, MS3202 or equivalent.

MS4811 MECHANICAL BEHAVIOR OF ENGINEERING MATERIALS (4-0).
The response of structural materials to mechanical stress is discussed with emphasis on plastic deformation in metals. Topics include elastic response and the modulus of elasticity; plasticity; deformation mechanisms and dislocation theory; strengthening mechanisms; and fatigue and fracture. Application of subject to materials development is also considered. PREREQUISITE: MS3202 or permission of instructor.

DEPARTMENT OF METEOROLOGY

Chih-Pei Chang, Professor (1972)*; PhD, University of Washington, 1972.

Jeng-Ming Chen, Adjunct Research Professor (1989); PhD, University of California at Los Angeles, 1989.

Kenneth L. Davidson, Professor (1970); PhD, University of Michigan, 1970.

George M. Dunnavan, Lieutenant Commander, U.S. Navy; Instructor (1989); MS, Naval Postgraduate School, 1983.

Philip A. Durkee, Associate Professor (1984); PhD, Colorado State University, 1984.

Russell L. Elsberry, Professor (1968); PhD, Colorado State University, 1968.

John W. Glendening, Adjunct Research Professor (1987); PhD, University of Washington, 1985.

George W. Haltiner, Distinguished Professor Emeritus (1946); PhD, University of Wisconsin, 1948.

Robert L. Haney, Chairman and Professor (1970); PhD, University of California at Los Angeles, 1971.

Patrick A. Harr, Adjunct Research Professor (1989); MS, Colorado State University, 1978.

Paul A. Hirschberg, Adjunct Research Professor (1990); PhD, Pennsylvania State University, 1989.

Teddy R. Holt, Assistant Professor (1989); PhD, North Carolina State University, 1989.

Frank L. Martin, Professor Emeritus (1947); PhD, University of Chicago, 1941.

Wendell A. Nuss, Assistant Professor (1986); PhD, University of Washington, 1986.

Patricia A. Pauley, Adjunct Professor (1990); PhD Purdue University, 1985.

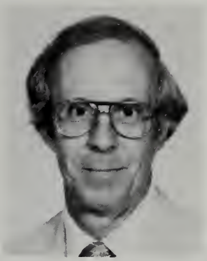
Melinda S. Peng, Adjunct Research Professor (1984); PhD, State University of New York at Albany, 1982.

Robert J. Renard, Distinguished Professor Emeritus (1952); PhD, Florida State University, 1970.

William J. Shaw, Associate Professor (1983); PhD, University of Washington, 1982.

Willem van der Bijl, Professor Emeritus (1961); PhD State University, Utrecht, 1952.

Carlyle H. Wash, Associate Professor (1980); PhD, University of Wisconsin, 1978.



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Curricular Matters
Roger T. Williams,
Professor,
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Forrest R. Williams, Adjunct Professor (1983); MS, Massachusetts Institute of Technology, 1972.

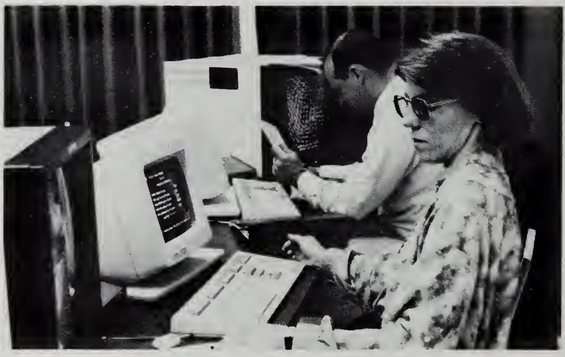
Roger T. Williams, Professor (1968); PhD, University of California at Los Angeles, 1963.

Tren-Chiang Yeh, Adjunct Research Instructor (1990); MS, National Central University (Taiwan), 1979.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

The Department of Meteorology is one of eleven departments and its history dates back to the 1940s when it was part of the Postgraduate Department at the Naval Academy. The department's academic function is interdisciplinary in nature in that it supports separate Master of Science Degree programs in Meteorology, Meteorology and Oceanography and Oceanography and also provides courses for the Space, Antisubmarine Warfare, Electronic Warfare and Command, Control and Communications (C3) curricula.

Department academic strengths include air/ocean dynamics and numerical modeling and prediction, structure and dynamics of the atmospheric boundary layer, satellite remote sensing and its applications and synoptic meteorology, including analysis and prediction in tropical, middle latitude and polar regions in both hemispheres. More than forty courses are offered in meteorology, primarily at the graduate level. The department has fourteen teaching faculty and seven adjunct research faculty, with graduate student participation as research-team members through the MS thesis and Ph.D. dissertation process. The current areas of research concentration encompass numerical and analytic air/ocean modeling and numerical weather prediction, tropical meteorology, including monsoon circulations and tropical cyclone forecasting, climate dynamics, marine boundary layer studies with emphasis on air/sea interactions and electromagnetic/optic propagation, remote sensing/ satellite meteorology and a wide range of synoptic studies (e.g., regional studies, maritime cyclogenesis, short range forecasting, numerical-model output verification).



Both Visiting Scientist and Navy-sponsored Research Chair programs are an integral part of the department's operation. The Ph.D. program in the department is active with Navy and Air Force Officers, DOD civilians and internationals among its recent graduates.

DEPARTMENT REQUIREMENTS FOR DEGREES

MASTER OF SCIENCE IN METEOROLOGY

Entrance to a program leading to a Master of Science degree in Meteorology requires a baccalaureate degree with completion of mathematics through differential and integral calculus and a minimum of one year of college physics.

The degree Master of Science in Meteorology requires completion of:

1) Necessary prerequisite courses in mathematics (through partial differential equations) and meteorology,

2) The sequence of core courses in the fields of dynamical, numerical, physical and synoptic meteorology,

3) An approved selection of graduate elective courses,

4) An acceptable thesis.

The total number of quarter hours in (2) and (3) above must be at least 36. These 36 hours must include 18-quarter hours at the 4000 level in courses other than directed study.

MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY

Direct entrance to a program leading to the degree Master of Science in Meteorology and Physical Oceanography requires a baccalaureate degree in one of the physical sciences, mathematics or engineering. This normally permits the validation of a number of required undergraduate courses such as physics, differential equations, linear algebra, vector analysis and various courses in meteorology and/or oceanography which are prerequisites to the graduate program. These prerequisites may be taken at the Naval Postgraduate School; however, in that event the program may be lengthened by one or more quarters.

The degree Master of Science in Meteorology and Physical Oceanography requires completion of:

1) Necessary prerequisite courses in mathematics (through partial differential equations), meteorology and physical oceanography,

2) The sequence of core courses in the fields of dynamical, numerical, physical and synoptic meteorology and oceanography,

3) An approved selection of graduate elective courses in meteorology and oceanography,

4) An acceptable thesis on a topic approved by either department.

The total number of quarter hours in (2) and (3) above must be at least 48. These 48 hours must include 20 hours at the 4000 level in courses other than directed study and they should show an approximate balance between the disciplines of meteorology and physical oceanography.

DOCTOR OF PHILOSOPHY

The Ph.D. program is offered in the Department of Meteorology in the following areas of study: numerical weather prediction, geophysical fluid dynamics, boundary-layer meteorology, analysis of atmospheric systems and tropical meteorology.

The requirements for the degree are grouped into three categories: course work, research in conjunction with an approved dissertation and examination in both the major and a minor field. The minor field is usually in physical oceanography, mathematics or physics.

The Department of Meteorology also may require a preliminary examination to show evidence of acceptability as a doctoral student.

Prospective students should consult with the Chairman of the Department of Meteorology for further guidance regarding doctoral programs.

LABORATORIES

In addition to the standard synoptic laboratories, NPS meteorological facilities include the Meteorology/Oceanography Interactive Digital Environmental Analysis Laboratory which provides real-time acquisition and analysis of conventional and remotely-sensed data in support of the synoptic and physical meteorology programs. The laboratory consists of 17 image analysis and graphics workstations hosted by a number of VAX computers with two tape drives and greater than six gigabytes of disc storage.

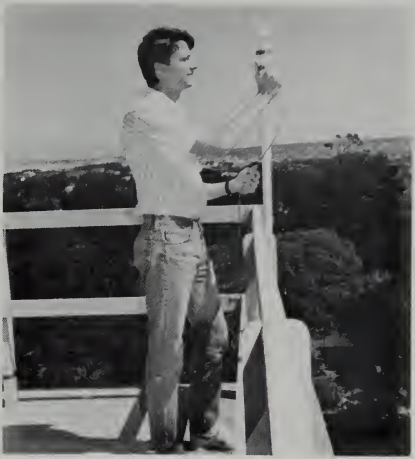
The department has also completed the installation of its new Marine Atmospheric Measurements Laboratory. This facility features state-of-the-art instrumentation for calibration work and for probing the atmosphere with both in situ and remote sensing devices. The laboratory features a 404.37 MHz doppler radar wind profiler, a Vaisala rawinsonde system with both Omega and LORAN-C navigational aids and a controlled temperature/humidity chamber which operates to -10 C while controlling humidity in the range of 5-98%.

The department has a variety of instruments for observing the atmosphere and equipment for receiving weather analyses and forecasts emanating from the National Weather Service, including the DIFAX facsimile network system, the COMEDS link to the Automated Weather Network and a RADAC Weather Radar Receiver, a real-time link to the nation-wide weather radar network. Additional information is received from Fleet Numerical Oceanography Center via the Naval Environmental Display System (NEDS). Weather satellite data are received on a UNIFAX recorder via GOESTAP and displayed in animated form by the Digital Weather Image Processing System. Rawinsonde equipment, acoustic sounders and micrometeorologically instrumented masts and an NSF-owned Research Vessel operated by the Moss Landing Marine Laboratory, are utilized by faculty and students in the meteorology and oceanography programs. Supplementing the school's extensive computer facilities, discussed in the General Information section of this catalog, the department also maintains its own Computer Facility to support faculty and staff research and student thesis/dissertation projects. Equipment includes a number of networked microcomputers, data and graphics terminals, plotters and printers.

COURSE OFFERINGS

MR0810 THESIS RESEARCH (0-0).
Every student conducting thesis research will enroll in this course.

MR0999 SEMINAR IN METEOROLOGY (NO CREDIT). (2-0).
Students present results of thesis or other approved research investigation.
PREREQUISITE: Concurrent preparation of thesis or other acceptable research paper.



MR2020 COMPUTER COMPUTATIONS IN AIR-OCEAN SCIENCES (1-2).
Introduction to FORTRAN and NPS mainframe computer as applied to elementary problems in oceanography and meteorology.
PREREQUISITES: Calculus and college physics.

MR2200 INTRODUCTION TO METEOROLOGY (4-0).
A introductory course that treats the composition and structure of the atmosphere, thermodynamic processes, forces and related small- and large-scale motions, air masses, fronts, severe storms, solar and terrestrial radiation, general circulation and weather forecasting.
PREREQUISITE: Department approval.

MR2210 INTRODUCTION TO METEOROLOGY/LABORATORY (4-2).
Same course as MR2200 plus laboratory periods illustrating lecture material, including weather map analysis over oceanic areas using satellite imagery. PREREQUISITE: Department approval.

MR2262 ELEMENTS OF WEATHER FORECASTING (1-2).
Survey of subjective and objective methods of atmospheric prognosis. Weather briefings illustrate applications of forecasting principles and use of satellite imagery. PREREQUISITES: MR3222, MR3230 or consent of instructor.

MR2300 OBSERVATIONS, INSTRUMENTS AND CLIMATOLOGY (3-2).
Surface and upper-air observations, including rawinsondes. Instruments used in synoptic observations. Climate classifications, changes and controls; basic statistical quantities used in climatology; applications to world climates. PREREQUISITE: Introductory Meteorology course (may be taken concurrently).

MR2413 METEOROLOGY OF ANTISUBMARINE WARFARE (3-1).
Atmospheric factors affecting the air-sea interface, and the marine atmospheric boundary layer; local and synoptic-scale atmospheric features relevant to electromagnetic and electro-optical wave propagation; hands-on experience with existing environmental effects assessment models. PREREQUISITES: Differential and integral calculus (may be taken concurrently).

MR2416 METEOROLOGY FOR ELECTRONIC WARFARE (2-0).
A survey of environmental factors affecting the propagation and attenuation of electromagnetic waves. Synoptic and climatological conditions associated with anomalous refraction are studied. Ionospheric phenomena associated with longer wavelength (Hf) propagation. Layers associated with high aerosol concentration and optical turbulence are identified. Hands-on experience with existing environmental effects assessment models. PREREQUISITES: Differential and integral calculus. (May be taken concurrently).

MR2419 ATMOSPHERIC FACTORS IN C3 (2-0).
A survey of atmospheric properties and processes affecting propagation of electromagnetic (EM) and electro-optical (EO) waves. Tropospheric phenomena associated with standard and anomalous EM wave propagation at wavelengths greater than 10 meters. Ionospheric phenomena associated with larger wavelength (Hf) propagation. PREREQUISITE: Enrollment in C3 curriculum.

MR2520 SURVEY OF AIR-OCEAN REMOTE SENSING (3-0).
Overview of systems for remote sensing of the atmosphere and oceans from space, and operational applications. PREREQUISITES: Undergraduate Physics and Calculus, or consent of instructor.

MR3140 PROBABILITY AND STATISTICS FOR AIR-OCEAN SCIENCE (3-2).
Basic probability and statistics, in the air-ocean science context. Techniques of statistical data analysis. Structure of a probability model, density distribution function, expectation and variance. Binomial, Poisson and Gaussian distributions. Conditional probability and independence. Joint distributions, covariance and central limit theorem. Transformations of random variables. Histograms and empirical distributions and associated characteristics such as moments and percentiles. Standard tests of hypotheses and confidence intervals for both one-and two-parameter situations. Regression analysis as related to least squares estimation. PREREQUISITE: Calculus.

MR3150 ANALYSIS OF AIR/OCEAN TIME SERIES (3-2).
Analysis methods for atmospheric and oceanic time series. Fourier transforms applied to linear systems and discrete data. Correlation functions, power density spectra and cospectra. Optimal design of air-ocean data networks. Laboratory work involves analysis of actual atmospheric and oceanic time series using principles developed in class. PREREQUISITES: MA3132 and a probability and statistics course.

MR3212 POLAR METEOROLOGY/OCEANOGRAPHY (4-0).
Operational aspects of arctic and antarctic meteorology. Polar oceanography. Sea-ice; amount, its seasonal distribution, melting and freezing processes, physical and mechanical properties, drift and predictions. PREREQUISITES: OC3240, MR3222 or consent of instructor.

MR3220 METEOROLOGICAL ANALYSIS (4-0).
Techniques of evaluation, interpretation and analysis of pressure, wind, temperature and moisture data, including weather satellite observations, with emphasis on the low and middle troposphere. Synoptic models of extratropical vortices, waves and frontal systems, with emphasis on three dimensional space structure and time continuity, including isentropic surfaces and vertical cross-section analysis. Introduction to analysis in the high troposphere and low stratosphere. PREREQUISITES: MR3420, MR/OC3321.

MR3222 METEOROLOGICAL ANALYSIS/LABORATORY (4-3).
Same as MR3220 plus laboratory sessions on the concepts considered in the lectures, with emphasis on the analysis of the low and middle troposphere, streamline and isotach analysis techniques, satellite interpretation, and vertical cross-section analyses. PREREQUISITES: MR3420, MR/OC3321.

MR3230 TROPOSPHERIC AND STRATOSPHERIC METEOROLOGY (4-0).
An analytic and synoptic interpretation of tropospheric and stratospheric systems with emphasis on the middle and high latitude aspects of extratropical cyclones, jet streams and fronts, and related dynamical properties. PREREQUISITES: MR3222; MR4322 (may be concurrent).

MR3234 TROPOSPHERIC AND STRATOSPHERIC METEOROLOGY/LABORATORY (4-4).
Same as MR3230 plus laboratory sessions utilizing the IDEA Lab to facilitate the physical understanding of dynamical relationships, including vorticity, divergence and vertical velocity. PREREQUISITES: Enrollment in Operational Physical Oceanography Curriculum or consent of Chairman; MR3222; MR4322 (may be concurrent).

MR3240 RADAR METEOROLOGY (3-0).
Principles of radar meteorology. Topics covered include radar systems, meteorological radar equation, doppler radar basics, propagation, attenuation, precipitation and velocity estimation, and characteristic echoes. PREREQUISITES: MR3222 and MR3522.

MR3250 TROPICAL METEOROLOGY (3-0).
Structure and mechanisms of synoptic-scale wave disturbances, cloud clusters, upper-tropospheric systems, the intertropical convergence zone; structure, development and motion of tropical cyclones; monsoon circulations. Emphasis on analysis and energetics. PREREQUISITES: MR4322 and MR3230 or MR3234 (may be concurrent).

MR3252 TROPICAL METEOROLOGY/LABORATORY (3-4).
Same as MR3250 plus laboratory sessions on analysis of tropical systems emphasizing streamline and isotach analysis and incorporating aircraft and satellite observations. Exercises stress tropical cyclone regimes. Satellite imagery is used as an analysis tool and also in forecasting tropical cyclone intensity. A track forecasting exercise provides an exposure to the use of various dynamic, climatological and statistical forecast models. PREREQUISITES: MR4322 and MR3230 or MR3234 (may be concurrent).

MR3254 TROPICAL METEOROLOGY/LABORATORY (3-2).
Same as MR3250, plus laboratory sessions stressing tropical general circulation, satellite interpretation and tropical cyclone structure. Tropical summary briefs and track forecasting exercises provide an understanding of the tropical cyclone warning system and the uses of various dynamical, climatological and statistical forecast models. PREREQUISITES: Enrollment in Operational Oceanography Curriculum or consent of Chairman, MR4322 and MR3230 or MR3234 (may be concurrent).

MR3260 OPERATIONAL ATMOSPHERIC PREDICTION (3-0).
Subjective and objective methods of atmospheric prognosis and techniques for forecasting operationally-important weather elements from surface to 100 mb. Interpretation, use and systematic errors of computer-generated products. Weather satellite briefs and applications of forecasting principles to current situations. PREREQUISITES: MR3230, or MR3234; MR/OC4323 or consent of Instructor.

MR3262 OPERATIONAL ATMOSPHERIC PREDICTION/ LABORATORY (3-5).
Same as MR3260 plus laboratory sessions on the application of lecture material. Also, practice in weather briefing, including diagnosis and forecasting of current weather situations using weather satellite observations, and Fleet Numerical Oceanography Center and National Meteorological Center products. PREREQUISITES: MR3230 or MR3234; MR/OC4323 or consent of instructor.

MR3321 AIR-OCEAN FLUID DYNAMICS (4-0).
The hydrodynamical equations for a rotating stratified fluid. Forces, kinematics, boundary conditions, scale analysis. Simple balanced flows; baroclinicity, thermal wind; vorticity and divergence: rotational and divergent part of the wind; circulation theorem. Vorticity and potential vorticity equations. PREREQUISITE: MA2047.

MR3420 ATMOSPHERIC THERMODYNAMICS (3-0).
The physical variables; properties of gases, water and moist air; equations of state and the laws of thermodynamics applied to the atmosphere; adiabatic processes and potential temperature; meteorological thermodynamic diagrams; geopotential and hydrostatic equilibrium, vertical motion in the atmosphere, stability criteria and condensation levels. PREREQUISITE: MA1116 or equivalent.

MR3421 CLOUD PHYSICS (3-0).
Basic principles of cloud and precipitation physics and application to weather modification. Selected topics in atmospheric pollution. PREREQUISITE: MR3420.

MR3445 OCEANIC AND ATMOSPHERIC OBSERVATIONAL SYSTEMS (2-2).
Principles of measurement: sensors, data acquisition systems, calibration, etc. Methods of measurement for thermodynamic and dynamic variables in the ocean and atmosphere, including acoustics and optics. PREREQUISITES: OC3230 and MR3420, MR/OC3150 or consent of instructor.

MR3455 MEASUREMENT SYSTEMS FOR THE MARINE AND COASTAL ATMOSPHERIC BOUNDARY LAYER (2-2).

The course treats a broad spectrum of measurement techniques for atmospheric dynamic and thermodynamic variables. Laboratory sessions provide hands-on experience with various state-of-the-art sensing systems, including NPS's new Doppler Radar Wind Profiler. Topics include sensor static and dynamic characteristics; calibration; in situ measurements of wind, pressure, temperature, humidity and radiation on the surface, on balloon-borne sounding systems and on aircraft; and surface-based remote sensing systems, including wind profilers, SODAR and LIDAR. PREREQUISITES: MR3222 and MR3150 or consent of the instructor.

MR3480 ATMOSPHERIC THERMODYNAMICS AND RADIATIVE PROCESSES (4-1).

State variables of gases; equation of state and thermodynamic laws; potential temperatures; latent heat and the Clausius-Clapeyron equation, hydrostatic equation, geopotentila height, adiabatic and pseudoadiabatic processes, various stability criteria; condensation levels and instability indices. Basic solar and terrestrial radiation theory; atmospheric energy budgets; climate change; radiative effects of clouds and aerosols. PREREQUISITE: MA1117 or equivalent.

MR3520 REMOTE SENSING OF THE ATMOSPHERE AND OCEAN (4-0).

Principles of radiative transfer and satellite sensors and systems; visual, infrared and microwave radiometry and radar systems; application of satellite remotely-sensed data in the measurement of atmospheric and oceanic variability. PREREQUISITES: Undergraduate physics and differential/integral calculus, ordinary differential equations and MR3480, or consent of instructor.

Lieutenant John Casey Church feels his time spent at the Naval Postgraduate School has helped him "to develop a higher level of academic and scientific maturity." Church, a recent fellowship recipient, is pursuing his Masters in Meteorology and Physical Oceanography in route to receiving his Ph.D. in Physical Oceanography.

The biggest difference he sees between NPS and other graduate schools is that other schools maintain a "generalist" approach while NPS provides the opportunity to work with practical applications currently in use by the Navy.

Church, along with his wife Jennifer and son Tom, look forward to the next three years on the peninsula. They enjoy exploring the area and spending time "after hours" strolling through the gardens and historic buildings of the school. "In fact, we have yet to have a person visit us whom we haven't taken over to the school for a tour of the museum and beautiful grounds."

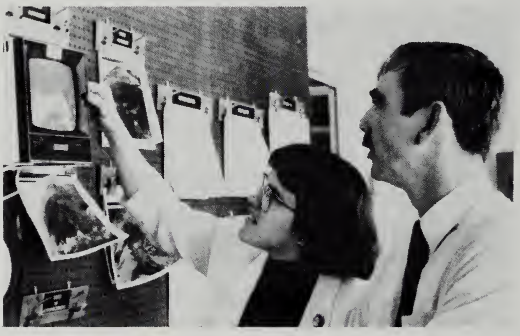
Following graduation in 1993, Church will be going to various oceanography and meteorology billets as a staff oceanographer.

MR3522 REMOTE SENSING OF THE ATMOSPHERE AND OCEAN/LABORATORY (4-2).
Same as MR3520 plus laboratory sessions on the concepts considered in the lecture series. PREREQUISITES: Same as MR3520.

MR3540 RADIATIVE PROCESSES IN THE ATMOSPHERE (3-0).
Applications of radiation theory to atmospheric energy budgets, general circulation and anthropogenic climate changes. Radiational imbalance at the surface leading to heat fluxes and temperature changes in atmosphere and earth. Upper atmosphere phenomena (ozonosphere and ionosphere). Radiative effects of clouds and aerosols, and optical phenomena. PREREQUISITES: MR3420, MR3520 or MR3522.

MR3570 OPERATIONAL OCEANOGRAPHY AND METEOROLOGY (2-4).
Experience at sea acquiring and analyzing oceanographic and atmospheric data using state-of-the-art instrumentation. Integration of satellite remote sensing and other operational products with in situ data. Includes survey of instrumentation, pre-cruise planning, operations at sea and post-cruise analysis. PREREQUISITES: OC3240 and MR3220, or consent of instructor.

MR4241 MESOSCALE METEOROLOGY (3-0).
Descriptive and physical understanding of subsynoptic-scale weather systems and their relation to the synoptic-scale environment. Applications to short-range and local-area forecasting utilizing satellite and numerical-model products relevant to mesoscale weather phenomena. PREREQUISITES: MR3230, MR/OC4323, or MR4322 with consent of instructor.



MR4242 ADVANCED TROPICAL METEOROLOGY (3-0).
Theories and observations of equatorial waves and low-frequency oscillations; energy sources and instabilities; monsoon circulations. Tropical cyclone models and forecasting; selected topics in diagnostic and theoretical studies of tropical flows. PREREQUISITES: MR3250 and consent of instructor.

MR4250 ATMOSPHERIC GENERAL CIRCULATION (3-0).
The observed circulation. Zonal mean and eddy motions. Balances of momentum, heat and moisture. Energetics. Maintenance of circulation. Zonally asymmetric circulations. Other selected topics of the general circulation of the atmosphere. PREREQUISITES: MR4322 and consent of instructor.

MR4322 DYNAMIC METEOROLOGY (4-0).
Pressure coordinates, scale analysis, perturbation method; solutions of equations of motion for sound, gravity and synoptic waves; baroclinic and barotropic instability; energetics; geostrophic adjustment. PREREQUISITE: MR3420, MR/OC3321, MA2047, MA2121 or equivalent.

MR4323 NUMERICAL AIR AND OCEAN MODELING (4-2).
Numerical models of atmospheric and oceanic phenomena. Finite difference techniques for solving hyperbolic, parabolic and elliptic equations, linear and nonlinear computational instability. Spectral and finite element models. Filtered and primitive equation prediction models. Sigma coordinates. Objective analysis and initialization. Moisture and heating as time permits. PREREQUISITES: MR4322, OC4211, MA3132; MA3232 desirable.

MR4324 ADVANCED NUMERICAL WEATHER PREDICTION (3-0).
Initialization, boundary conditions; sensible, latent and radiative heat transfer; simulation of sub-grid scale processes such as convection and friction; spectral methods and finite element models; general circulation models. PREREQUISITE: MR/OC4323 or consent of instructor.

MR4331 ADVANCED GEOPHYSICAL FLUID DYNAMICS I (3-0).
Advanced topics in the dynamics of the atmosphere and the oceans including scale analysis; geostrophic adjustment; dispersion, and barotropic and baroclinic instabilities. PREREQUISITE: Consent of instructor.

MR4332 ADVANCED GEOPHYSICAL FLUID DYNAMICS II (3-0).
Normal mode and absolute baroclinic instability; frontogenesis; boundary layer analysis with application; finite amplitude baroclinic waves. PREREQUISITE: Consent of instructor.

MR4413 AIR-SEA INTERACTION (4-1).
Fundamental concepts in turbulence. The atmospheric planetary boundary layer, including surface layer and bulk formulae for estimating air-sea fluxes. The oceanic planetary boundary layer including the dynamics of the well-mixed surface layer. Recent papers on large-scale air-sea interaction. PREREQUISITES: MR/OC3150 and OC3240 or MR4322, or consent of instructor.

MR4414 ADVANCED AIR/SEA INTERACTION (3-0).
Advanced topics in the dynamics of the atmospheric and oceanic planetary boundary layers. PREREQUISITE: MR/OC4413 or consent of instructor.

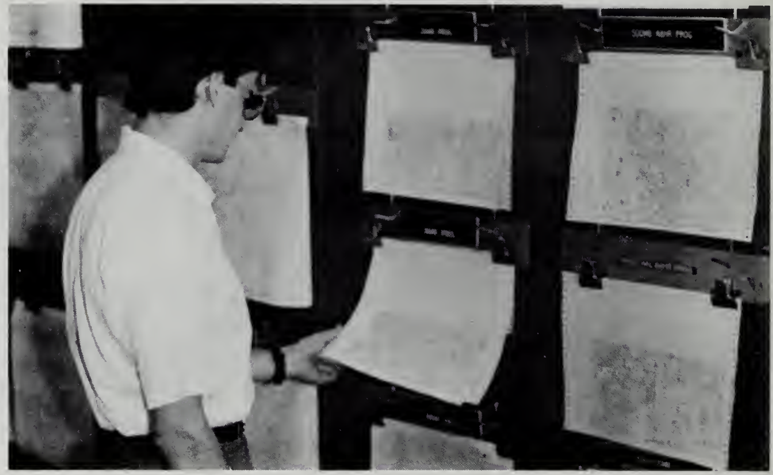
MR4415 ATMOSPHERIC TURBULENCE (3-0).
Approaches for defining the structure of the turbulent atmospheric boundary layer. Review of statistical descriptions of atmospheric turbulence; averaging, moments, joint moments, spectral representation. Equations for turbulent regime in a stratified, shear flow. Scaling parameters and similarity theories for surface layer profiles, spectra; Kolmogorov hypotheses, Monin-Obukhov similarity theory. Measurement of atmospheric turbulence. Examination of observed spectra and scales of atmospheric turbulence. PREREQUISITE: MR/OC3150 or consent of instructor.

MR4416 ATMOSPHERIC FACTORS IN ELECTROMAGNETIC AND OPTICAL PROPAGATION (4-0).
Principles of microwave and optical wave propagation in the atmosphere. Effects of surface and boundary layers on propagation: refraction, scattering, attenuation, ducting, etc. Hands-on experience with existing environmental effects assessment models. PREREQUISITE: MR/OC4413 or MR4415 (may be concurrent).

MR4520 TOPICS IN SATELLITE REMOTE SENSING (3-0).
Selected topics in the advanced application of satellite remote sensing to the measurement of atmospheric and oceanic variables. PREREQUISITE: MR/OC3522.

MR4800 ADVANCED TOPICS IN METEOROLOGY (Variable credit) (V-0).
Advanced topics in various aspects of meteorology. Topics not covered in regularly offered courses. The course may be repeated for credit as topics change. PREREQUISITE: Consent of Department Chairman and instructor.

MR4900 DIRECTED STUDY IN METEOROLOGY (Variable credit) (V-0).
Directed study of selected areas of meteorology to meet the needs of the individual student. PREREQUISITE: Consent of Department Chairman and instructor. Graded on Pass/Fail basis only.



DEPARTMENT OF NATIONAL SECURITY AFFAIRS

Donald Abenheim, Assistant Professor (1985)*; PhD, Stanford University, 1985.

John William Amos, II, Associate Professor (1970); PhD, University of California at Berkeley, 1972.

Loftur L. Bjarnason, Professor Emeritus (1958); PhD, Stanford University, 1951.

Sherman Wesley Blandin, Jr., Professor Emeritus (1968); PhD, University of Santa Clara, 1977.

Jan S. Breemer, Associate Chairman and Assistant Professor (1988); PhD, University of Southern California, 1987.

R. Mitchell Brown, III, Commander, U.S. Navy (1989); OP-06 Chair of Strategic Planning; MA, Naval Postgraduate School, 1980.

Thomas C. Bruneau, Chairman and Professor (1987); PhD, University of California at Berkeley, 1970.

Claude A. Buss, Adjunct Professor (1976); PhD, University of Pennsylvania, 1927.

Ralph Norman Channell, Adjunct Professor (1987); MA, Boston University, 1964.

Thomas B. Grassey, Associate Professor (1987); PhD, University of Chicago, 1983.

Boyd Francis Huff, Professor Emeritus (1958); PhD, University of California, Berkeley, 1955.

Roman Laba, Assistant Professor (1990); PhD, University of Wisconsin, 1989.

Edward John Laurance, Associate Chairman and Professor (1972); PhD, University of Pennsylvania, 1973.

Robert Edward Looney, Professor (1979); PhD, University of California at Davis, 1969.

Ralph Harry Magnus, Associate Chairman and Associate Professor (1976); PhD, University of California at Berkeley, 1971.

Edward Allan Olsen, Professor (1980); PhD, The American University, 1974.

Patrick Johnston Parker, Professor (1974); MBA, University of Chicago, 1955.

Kamil T. Said, Adjunct Professor (1975); MA, San Jose State College, 1967.

Joseph Sternberg, Professor (1985); PhD, Johns Hopkins University, 1955.

Paul N. Stockton, Assistant Professor (1990); PhD, Harvard University, 1986.

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Russel Henry Stolfi, Professor (1966); PhD, Stanford University, 1966.

Frank Michael Teti, Associate Professor (1966); PhD, Syracuse University, 1966.

Scott D. Tollefson, Adjunct Professor (1988); PhD, Johns Hopkins University, 1989.

James John Tritten, Associate Professor (1986); PhD, University of Southern California, 1984.

Mikhail Tsypkin, Assistant Professor (1987); PhD, Harvard University, 1985.

James J. Wirtz, Assistant Professor (1990); PhD, Columbia University, 1989.

David Scott Yost, Associate Professor (1979); PhD, University of Southern California, 1976.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

The Department of National Security Affairs offers programs of study in three major fields, supporting eight different curricula. The three major fields encompass Strategic Planning and Intelligence, International Organizations and Negotiations and Geographic area studies. The area studies are subdivided into five groups as follows:

- Middle East, Africa and South Asia
- Far East, Southeast Asia and the Pacific
- Western Hemisphere
- Western Europe
- Soviet Union and Eastern Europe

Individual programs in the area studies focus on one of the subregions listed or contain a blend of all subregions in the area. The area studies program may include a program of study in a language of the area at the Defense Language Institute, located in Monterey.

The field of strategic planning includes both general and nuclear strategic planning. Individual programs focus on the evolutionary history of the planning process, strategies for national security, naval and maritime strategy and management and planning systems.

The intelligence curriculum is an interdisciplinary program which integrates political science, mathematics, operations analysis, oceanography, aeronautical engineering, electrical engineering, physics, information systems and managerial economics into an understanding of intelligence.

Coursework addresses three broad fields: defense technology, analysis and management and national security affairs. The defense technology courses are designed to address the special problems of technical intelligence, emphasizing technical literacy and the ability to communicate concerning technological and environmental problems. This sequence seeks to provide the perspective that will assist assessment of the reality and significance of technical and environmental data, as well as ensure familiarity with the resources in these fields that may be applied to intelligence problems.

The analysis and management coursework provides the student with a grounding in quantitative techniques, substantive research methods and the concepts of resource management. Students are introduced by various means to structure given problems, formulate possible solutions, organize and compile supporting data, assess the reliability and communicate the significance of the results obtained.

Graduate courses in National Security Affairs outline the interface between international politics, national security objectives, resource management and weapons technology. The sequence synthesizes the political, technological, economic, cultural, social and ideological forces that influence the actors in the international system and models varying scenarios of interaction between them.

David Yost
Associate Professor, National Security Affairs

David Yost is on a Fulbright Fellowship in France through June 1991. In his 11 years at NPS, Yost has spent three in Washington on fellowships: with the Council on Foreign Relations, with the Smithsonian Institution and at Johns Hopkins University. “The school has always been very supportive of such outside enrichment activities,” says Yost. “This is one of the advantages of the Naval Postgraduate School.”

He also considers NPS a unique place to teach for other reasons. At the top of the list are the students. “The students are very mature professionals. They have usually served eight to ten years of active duty, so they can contribute a lot to the courses.”

He lists the opportunities for specialization and research as two more strengths. “We have courses not found at most civilian institutions. In my department we have several courses devoted to problems of nuclear weapons and arms control; at most civilian universities one would be fortunate to find one course a year dealing with such issues. And support for these activities comes not only from the school’s own resources but from various government agencies as well.”

Two further advantages, according to Yost, are access to classified materials and interdisciplinary work. “Especially in our work in the national security area, we can tackle topics with greater depth and authority than might be possible using only unclassified sources,” he states. “And here, a person like me who studies politics and international relations can work with technical experts, highly qualified scientists, to gain insight on such subjects as antisubmarine warfare, space systems, and command, control and communications.”

Yost concludes, “We have so many students from the other services that, in a sense, it’s not only a naval school but a defense and national security school. The scientific and technical departments have quite a few foreign students. I think it’s enriching for our students and faculty to work with them and get another perspective.”

DEPARTMENTAL REQUIREMENTS FOR THE DEGREE MASTER OF ARTS IN NATIONAL SECURITY AFFAIRS

1) At least 44 units of approved graduate study pertinent to the field of National Security Affairs, of which at least 16 units must be at the 4000 level.

2) The completion of an approved sequence of courses in one of the areas of concentration:

    a. Area Specialization: Completion of graduate courses in the geographic area of specialization, including a 4000 level course.

    b. Functional Specialization: Completion of graduate courses in either Strategic Planning or International Organizations and Negotiations, including a 4000 level course.

3) Successful completion of departmental comprehensive examination or completion of an acceptable thesis.

4) Language proficiency, when applicable, for geographic area specialization.

DEPARTMENTAL REQUIREMENTS FOR THE DEGREE MASTER OF SCIENCE IN NATIONAL SECURITY AFFAIRS

The degree Master of Science in National Security Affairs will be awarded upon the completion of an interdisciplinary program carried out in accordance with the following degree requirements:

1) A minimum of 45-quarter hours of graduate level work of which at least 12 hours must represent courses at the 4000 level. Graduate courses in at least three different academic disciplines must be included and in two disciplines a course at the 4000 level must be included.

2) An approved sequence of at least three courses constituting advanced study in an area of specialization must be included.

3) In addition to the 45 hours of course credit, an acceptable thesis must be completed.

4) The program must be approved by the chairman of the Department of National Security Affairs.

COURSE OFFERINGS

NS0810 THESIS RESEARCH (0-0).
Students conducting thesis research will enroll in this course.

NS0811 PREPARATION FOR COMPREHENSIVE EXAMINATION (NO CREDIT) (0-4).
Students preparing for comprehensive examinations will enroll in this course.

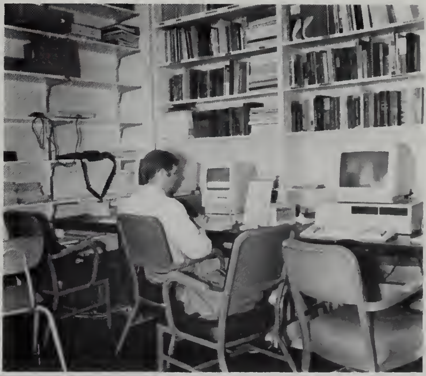
NS0855 EXPERIENCE TOUR (0-0).
Thesis research assignment to the Naval Technical Intelligence Center for selected students in Track 1, or to the Naval Operational Center for selected students in Track 3A. Requires TOP SECRET clearance with eligibility for SPECIAL INTELLIGENCE information and approval of Academic Associate for Intelligence.

NS1500 AMERICAN LIFE AND INSTITUTIONS (3-0).
American political institutions and the political, social, economic and cultural aspects of American Life. OPEN TO ALLIED OFFICERS. Graded on Pass/Fail basis only.

NS2060 GAMING AND SIMULATION LAB FOR NATIONAL SECURITY AFFAIRS (2-2).
Introduction to the basic principles and concepts of strategic simulation and gaming using the RAND Strategy Assessment System (RSAS). Topics include the general architecture of the system, nature of the variables and models embedded in RSAS, and the basics of the RAND-ABEL language and the use of IF-THEN-ELSE tables. Students will conduct experiments in sensitivity analysis, net assessment, strategic planning, threat assessment and high level gaming. PREREQUISITES: Any introductory microcomputer course, SECRET clearance, and U.S. citizenship. Limited to U.S. military or U.S. government employees.

NS2150 SURVEY OF SCIENCE AND TECHNOLOGY (4-0). An overview of scientific principles and technological factors relevant to intelligence capabilities. Topics include: oceanographic, meteorological and astronomic environmental considerations; electromagnetic wave propagation, including communication, radar and laser fundamentals; basic aerodynamics and orbital mechanics; weapons design and effects; concepts of remote sensing.

NS2154 INTELLIGENCE AND THE MILITARY (4-0).
An overview of the intelligence structure and a survey of the intelligence process focusing on the application of intelligence to the military mission. The organization and functions of the various elements of the intelligence community are presented. Primary emphasis is placed on the use of intelligence by military decision makers. Included are overviews of systems supporting the collection, production and dissemination of intelligence. The course is intended for the non-intelligence specialist and is available to any student wishing to learn about the intelligence community and its ability to provide support to the military.



NS3000 MILITARY HISTORY: WAR IN THE MODERN WORLD (4-0).
Study of the history of war since 1815. Course emphasizes the connection between the events of war, strategy and policy in the international system of states. The class compares the military experience of the leading world powers, seeking to demonstrate how war has become total in the modern age. The different national experiences with policy, strategy, operations and tactics form the central focus of the course. Students are expected to prepare an individual project on a selected problem of the history of war for presentation to the class.

NS3011 POLICY ANALYSIS AND RESEARCH METHODS FOR AREA STUDIES (4-0).
Survey of methods and techniques used in social scientific inquiry as applied to the study of specific areas and regions. Topics include policy research design, operationalization and measurement, sampling, and generation of data using survey research, interviewing, content analysis, analysis of elites, event data analysis, and archival and bibliographic research techniques. Particular emphasis is placed on the cross-national comparative approach. Students will be introduced to the microcomputer and its applicability to regional security studies. Students will conduct several projects requiring the generation and analysis of data related to national security issues of specific areas and regions.

NS3012 RESEARCH METHODS FOR STRATEGIC PLANNING AND INTELLIGENCE (4-2).
Survey of the methods and techniques used in social scientific inquiry and their application to strategic planning research and the analysis of intelligence problems. Topics include policy research design, operationalization and measurement, sampling, and generation of data using survey research and interviewing, scaling techniques, event data analysis, and content analysis. Hypothesis testing will be emphasized, using both statistical methods and the method of structured, focused comparison of case studies. Special emphasis is placed on applying the principles and methods of social science to the general problem of indications and warning.

NS3013 FORECASTING METHODS FOR STRATEGIC PLANNING (2-2).
Survey and application of the methods and techniques used in forecasting the military, political and economic trends and events applicable to national security strategic planning. Methods covered include trend analysis and extrapolation, delphi and cross-impact matrix techniques, expert forecasting, scenario building, expert judgement techniques, expert systems, and simulation and modeling. PREREQUISITE: NS 3012.

NS3022 THE INTERNATIONAL CONTEXT FOR STRATEGIC PLANNING (4-0).
Survey of concepts, processes and historical developments which define the present and future international environment for strategic planning, international negotiations and intelligence. This course will utilize the systems approach to integrate the strategic planning effort at the institutional level with regional and global factors. These factors include actors, interactions and environmental components such as technology, ideologies, value systems, geopolitics and ecology.

NS3023 CONCEPTS OF INTERNATIONAL RELATIONS AND COMPARATIVE POLITICS (4-0).

Examination of critical concepts and analytical frameworks used in studying inter-state and intra-state politics. The study of the international environment emphasizes elements of national power, dynamics of state conflict, forces affecting state actions, conflicting values, ideologies and the international order. The comparative politics portion of the course focuses on models of nation building, mobilization, elite recruitment, regime types, the dynamics of intra-state political violence and the impact of varying socio-economic conditions on political structures and functions.

NS3030 AMERICAN NATIONAL SECURITY POLICY/DEFENSE ORGANIZATION (4-0).

An institutional and functional analysis of the national and international factors which shape U.S. defense policy. Attention in the course is focused on two major areas: 1) the decision-making process, including the legislative-executive budgetary process, as well as the influence of bureaucratic politics and interest group participation upon defense decisions; 2) the problems of strategic choice, including security assistance, threat analysis, net assessment, deterrence theory and limited war.

NS3035 U.S. FOREIGN POLICY IN ASIA, AFRICA, LATIN AMERICA, AND THE MIDDLE EAST (4-0).

Analyzes the evolution of global trends in U.S. foreign relations. Examines the domestic roots, governmental institutions, and the political, economic and security dimensions of U.S. foreign policy. Assesses the consequences of U.S. policy in Asia, Africa, Latin America and the Middle East.

NS3036 THE MILITARY AND POLITICS IN THE DEVELOPING WORLD (4-0).

Assesses the diverse roles of the armed forces in Africa, Asia, Latin America, and the Middle East. Special emphasis is placed on the non-military roles of the armed forces in society. Following a conceptual overview, specific case studies will be examined.

NS3037 THE ROLE OF CONGRESS IN U.S. NATIONAL SECURITY POLICY (4-0).

Survey of the roles, processes and orientations of the U.S. Congress in making national security policy. The course examines the powers and responsibilities granted to Congress by the Constitution, how the role of Congress has changed over time, and the way that role may evolve in the future. Specific topics include the budget process, War Powers, security assistance and the problems of executive-legislative coordination in foreign and military policy making.

NS3040 THE POLITICS OF GLOBAL ECONOMIC RELATIONS (4-0).

An integrated analysis on the economic and political factors that together determine national and international economic arrangements. The student first addresses the general principles of public finance as a prerequisite for the analysis of budgets and policy priorities in specific countries and areas. The remainder of the course is concerned with the changing world economic order including issues such as trade, aid, cross national security assistance, multi-national corporations technology and strategic resources.

NS3041 COMPARATIVE ECONOMIC SYSTEMS (4-0).
An examination of the economic systems and development problems in developing countries and the eastern bloc states. The course focuses on the political and ideological bases of economic organizations, and the nature of basic economic problems in these regions. Special attention is given to the socio-economic strategies and tactics used in the management of the economy, emphasizing the relevant assumptions, and institutions and techniques of decision making. Attention is also given to problems of economic stabilization in the developing world, and the economic crisis facing the eastern bloc states.

NS3050 MARITIME STRATEGY (4-0).
A policy oriented analysis of the maritime and naval components of our national military strategy. Introduces to the student the relationship of war at sea and other uses of the sea to what happens ashore. Introduces to the student the use of maritime assets for political gain and the impact of technology on maritime roles, missions and capabilities. Students are expected to prepare an individual project for presentation to the class. PREREQUISITE: NS3000 or permission of instructor.

NS3151 INTELLIGENCE SYSTEMS AND PRODUCTS (4-0).
This course is intended for students in the command and control program. It provides an introduction to intelligence systems and products which support command decision making, an overview of Soviet command and control concepts and practices required for an appreciation of the significance of intelligence reporting, an insight into intelligence procedures to provide perspective for operational security planning and material on Soviet intelligence organizations and capabilities. PREREQUISITES: TOP SECRET clearance with eligibility for SI/SAO, U.S. Citizenship. SPECIAL INTELLIGENCE information.

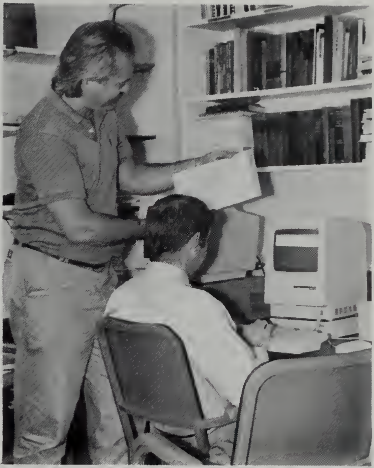
NS3152 NAVAL WARFARE AND THE THREAT ENVIRONMENT (4-0).
This course supports NPS warfare curricula. It concentrates on the threat posed by Soviet naval warfare forces to successful accomplishment of the U.S. Navy's missions. Issues include: U.S. missions in conflict situations: U.S. intelligence and analysis of the Soviet threat; the politico-military and strategic contexts underlying the use of Soviet naval and other forces for maritime warfare; current status and trends in Soviet naval warfare capabilities; continuities and changes in the missions and operations of Soviet naval and related forces; trends in the superpower naval warfare balance. SECRET clearance is required.

NS3159 PRINCIPLES OF OPERATIONAL INTELLIGENCE (4-0).
The concepts, principles and methods of all-source, time-urgent support to meet operational commanders' intelligence requirements across the entire spectrum of conflict. Indications and warnings, EEIs and collection plans, intelligence watch and battle staff functioning, crisis management, mission planning, tasking of non-organic intelligence assets, operational security and deception. Case studies will be emphasized. PREREQUISITES: TOP SECRET clearance with eligibility for SPECIAL INTELLIGENCE information.

NS3230 STRATEGIC PLANNING AND U.S. NATIONAL SECURITY POLICY (4-0).
The focus of this course will be on long-term strategic planning and will include such topics as: Strategic Goal Analysis, national and transnational power assessment, analysis of the decision making and administrative processes at the national level, indigenous constraints on the policy process, forecasting and future research techniques and the application of the concepts of strategic planning to the national defense effort. PREREQUISITE: NS3030.

NS3250 THE ECONOMICS OF U.S. DEFENSE POLICY (4-0).
An examination of the manner in which economic constraints affect the defense allocation process in the Unites States. Emphasis is placed on the macroeconomic environment in which the budget process is undertaken. Topics include: factors affecting defense expenditures, budgeting for defense, the impact of defense spending on the economy, manpower, and the structure, conduct and performance of defense industries.

NS3252 JOINT & MARITIME STRATEGIC PLANNING (4-0).
The Student will have a graduate-level understanding of strategy, especially maritime strategy, naval doctrine and the effect of technical developments on warfare. The student will become familiar with the following subjects for the United States, its allies and opponents: The roles and missions of military services, policy making processes regarding the armed forces, history of joint and general staffs, joint planning for acquisition and operations and current issues in defense reform and reorganization. Required for all U.S. officer students. PREREQUISITES: U.S. citizenship, SECRET clearance.



NS3279 DIRECTED STUDIES IN NATIONAL SECURITY AFFAIRS (Credit open 1-0 to 4-0) (V-0).
Format and content vary. Normally involves extensive assigned readings, individual discussions with the instructor, papers and/or examinations.

NS3280 NUCLEAR WEAPONS AND FOREIGN POLICY (4-0).
An interdisciplinary course which covers both the technology and political influences of nuclear weapon systems with the foreign policies of the major powers and the political blocs from 1945 to the present.

NS3300 FOUNDATIONS OF MIDDLE EASTERN POLITICS: PEOPLE, SOCIETIES, CULTURES AND RELIGIONS (4-0).
An intensive course in Middle Eastern history from the viewpoint of geographical and military factors which have shaped the course of events in the area. The geographic (including oceanographic) environment within which military campaigns have been conducted, which continues to present military problems, is examined. Indigenous and foreign techniques and tactics for dealing with this environment, as well as the historical development of Middle Eastern military organizations are studied.

NS3310 PROBLEMS OF GOVERNMENT AND SECURITY IN THE MIDDLE EAST (4-0).
An introductory course in Middle Eastern society and politics designed to provide the maximum background area knowledge to be utilized in follow-on courses in Middle Eastern politics.

NS3320 INTERNATIONAL RELATIONS AND SECURITY IN THE MIDDLE EAST (4-0).
The course focuses on selected problems affecting American security interests in the Middle East: strategic waterways, including the Suez Canal, the Turkish Straits and the Indian Ocean; the politics and problems of access to the area's oil resources; the development of U.S. and Soviet policies toward area. The foregoing problems will be set in the context of regional international politics.

NS3360 NORTH AFRICA: PROBLEMS OF GOVERNMENT AND SECURITY IN THE MAGHREB (4-0).
This course is designed to extend the student's knowledge of selected North African and Red Sea littoral countries and to provide some insight into the security problems presented by their domestic politics. In addition, some coverage of central African countries will be included.

NS3361 PROBLEMS OF GOVERNMENT AND SECURITY IN ISRAEL (4-0).
Israeli cultural, social and political patterns: Hebraic traditions, Zionism and the creation of Israel, institutional and sociological frameworks for Israeli politics, elite recruitment, perceptions and strategic orientations, security issues in Israeli domestic and foreign policy. PREREQUISITE: NS3310 or NS3320, or their equivalent.

NS3362 INTERNATIONAL RELATIONS AND SECURITY PROBLEMS IN THE ARABIAN PENINSULA AND ADJACENT AREAS (4-0).
This course examines the domestic, regional and external sources of conflict and cooperation in the region stretching from the Red Sea to the Arabian Sea centered on the Arabian Peninsula. This strategic region has recently been the scene of one of the most destructive regional wars in history (the Iran-Iraq War), as well as one of the most active regional cooperation organizations (the Gulf Cooperation Council). Emphasis will be placed on the differing security perspective of major regional states and their efforts to assure security through national development, bilateral, multilateral and regional organizational means. The historical and contemporary role of the United States in the area, including the USCENTCOM and its responsibilities is examined in depth.

NS3400 DOMESTIC CONTEXT OF SOVIET NATIONAL SECURITY POLICY (4-0).
An examination of the role of domestic factors shaping Soviet international conduct, including historical influences, ideology, political and economic systems, nationalities and political culture.

NS3401 THE PEOPLE OF USSR AND EASTERN EUROPE (4-0).
This course introduces the students to history and cultures of the people of USSR and Eastern Europe. The goal of the course is to give students the background necessary to evaluate the current progress of change in this area.

NS3410 SOVIET NATIONAL SECURITY (4-0).

A follow-up course to NS3400. Examination of the evolution of Soviet national security policy. Introductory part of the course deals with pre-World War II roots of Soviet national security policy and evolution of Soviet national security decision making. The main part of the course deals with Soviet national security policy from the end of World War II to the present, with special emphasis on US-Soviet relations, relations between the USSR and China and Soviet use of force in Eastern Europe and the Third World (Middle East, Angola, Ethiopia, Afghanistan). PREREQUISITE: NS3400 or consent of instructor.

NS3450 SOVIET MILITARY STRATEGY (4-0).

Examination of international and external factors conditioning Soviet military doctrine and strategy and their development through the Stalin, Khruschev and Brezhnev eras and beyond. Emphasis is on contemporary Soviet strategic concepts and strategy: surprise and deception, war-fighting capabilities, external role of the Soviet armed forces, strategy for nuclear war, Warsaw Treaty Organization strategy and Soviet naval strategy in the Third World.

NS3452 THE NAVY IN SOVIET STRATEGY (4-0).

Examination of the roles played by the Soviet Navy, Merchant Marine, fishing fleet and oceanological establishment in securing the objectives of the Soviet Government. Topics include: geographic factors affecting Soviet ocean strategies; non-naval strategy trends; international and domestic factors affecting post-1953 naval strategy, development of Soviet naval warfare capabilities; doctrinal and functional analysis of post-1953 trends in naval strategy; command structure; personnel training; law of the sea positions; U.S.-Soviet naval interaction. PREREQUISITE: NS3450 or permission of instructor and SECRET clearance.

NS3460 PROBLEMS OF GOVERNMENT AND SECURITY IN EASTERN EUROPE (4-0).

This course analyzes the political, economic, national security and international affairs of the communist-ruled states of Europe other than the Soviet Union.

NS3500 PERSPECTIVES ON AMERICAN CIVILIZATION (4-0).

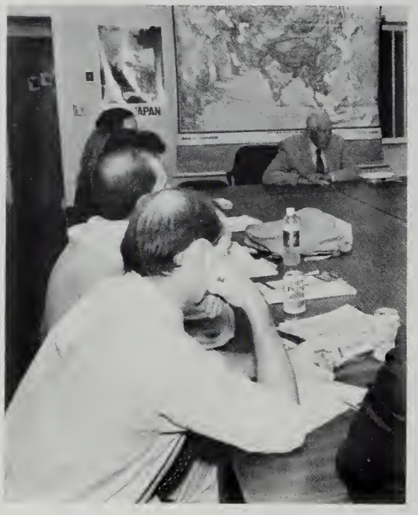
This course, especially designed for the foreign area studies (ATTACHE) program, is an interdisciplinary study of American culture, involving the political economic, social, philosophical and literary development of the Nation from 1789 to the present.

NS3501 HISTORY AND CULTURE OF LATIN AMERICA (4-0).

Identifies those aspects of the heritage most relevant to understanding contemporary conditions in Latin America, from pre-Columbian Indian traditions and Iberian colonial patterns through the independence movements of the early 19th century and the global economic relationships which re-oriented the region toward Northwestern Europe and the United States.

NS3510 PROBLEMS OF GOVERNMENT AND SECURITY IN LATIN AMERICA (4-0).

Considers the nature of political legitimacy in Latin America. Comparative studies indicate the relative role of revolutionary movements, constitutionalism and economic output as sources of social cohesion. Major political factors such as technocrats, organized labor, the church, political parties and the military are studied in reference to how they respond to demand for radical change. Critical analysis of government capacity to meet challenges indicates the degree to which countries in the region face a significant likelihood of instability stemming from internal and/or external sources. Specific countries are given attention based on the future assignments of the students.



NS3520 INTERNATIONAL RELATIONS AND SECURITY PROBLEMS OF LATIN AMERICA (4-0).

Surveys the attempts by countries from various parts of the world - including the Soviet block - to penetrate Latin America. The influences of cultural and economic ties, military sales and political subversion have created links between Latin America and Europe with an undercurrent of African relations. The activities coming from outside the region are evaluated in comparison with the efforts of Latin American states to gain diplomatic influence in global organizations and to establish economic links to serve development goals.

NS3600 GEOGRAPHY, HISTORY AND CULTURES OF EAST ASIA (4-0).

An introduction to East Asia. This basic course addresses the peoples of East Asia and their cultures, civilizations, social organization, economic, political and military development through the mid-19th century. This course is a prerequisite for the advanced courses on Asia.

NS3601 GEOGRAPHY, HISTORY, AND CULTURES OF SOUTH AND SOUTHEAST ASIA (4-0).

An introduction to South and Southeast Asia. This basic course addresses the people of South and Southeast Asia and their cultures, civilizations, social organization, economic, political, and military developments through the mid-19th century. This course is a prerequisite for the advanced courses on Asia.

NS3620 ASIA AND THE MODERN WORLD (4-0).

An analysis of major national and international developments within Asia, and between Asia and the non-Asian world from the mid-19th century to the mid-20th century.

NS3661 PROBLEMS OF GOVERNMENT AND SECURITY IN CHINA (4-0).

The rise of the Chinese Communist Party and the establishment of the Communist state; its domestic achievements and problems; the special problem of Taiwan; changing foreign policies and the current role of the Peoples Republic of China in world affairs.

NS3662 PROBLEMS OF GOVERNMENT AND SECURITY OF CONTEMPORARY JAPAN (4-0).
The place of Japan in the contemporary world; an examination of Japan's political dynamics, economic evolution, social transformation, the National Self Defense Forces and alternatives for providing for national security.

NS3663 PROBLEMS OF GOVERNMENT AND SECURITY OF CONTEMPORARY KOREA (4-0).
Division of the Korean nation into two states; the aftermath of Korean war; domestic, political, economic and social problems of North Korea and South Korea; the prospects for reunification; the military balance and the changing strategic environment; the relations of Pyongyang and Seoul with their key allies.

NS3667 PROBLEMS OF GOVERNMENT AND SECURITY IN SOUTH ASIA, SOUTHEAST ASIA AND OCEANIC REGIONS (4-0).
Internal problems and foreign relations among the states in the region of South Asia, Southeast Asia, Australia, New Zealand and Melanesia. Strategic interests of the major powers and importance of the Indian Ocean and Southwestern Pacific ocean area to superpowers and nations of the region.

NS3700 HISTORY OF EUROPE, 1815 - 1914.
Review and analysis of the political and military history of Europe, including Russia, from the Congress of Vienna to the outbreak of World War I.

NS3710 PROBLEMS OF GOVERNMENT AND SECURITY IN CONTEMPORARY WESTERN EUROPE (4-0).
Review and analysis of the history of Western Europe since 1945, including an introduction to the institutions of the European Economic Community and the North Atlantic Treaty Organization. Emphasis is on the political systems and security policies of Britain, France, Italy and the Federal Republic of Germany.

NS3720 INTERNATIONAL RELATIONS AND SECURITY PROBLEMS OF THE NORTH ATLANTIC ALLIANCE (4-0).
The origins and evolution of NATO in relation to the provided threat from the East and the postwar recovery of Europe. Problems of strategy, force posture, alliance cohesion, nuclear policy and the differing interests of NATO states. Current issues facing the alliance and their relation to U.S. foreign and defense policy.

NS3765 PROBLEMS OF GOVERNMENT AND SECURITY ON NATO'S FLANKS (4-0).
Introduction to the security problems in the Mediterranean and Scandinavian Baltic regions and the naval role on the flanks of NATO.

NS3900 INTERNATIONAL ORGANIZATIONS AND NEGOTIATIONS (4-0).
The first part of the course traces the evolution of international organizations from the Concert of Europe, through the League of Nations, United Nations, European Economic Community, NATO and various current forms of multi-national and transnational organizations. The emphasis is on policy making in these organizations. The second part of the course is an analysis of international negotiations, with emphasis on applying theories of negotiations to such issues as Law of the Sea and Arms Control.

NS3902 MODERN REVOLUTION AND POLITICAL TERRORISM (4-0).
Study of the general historical framework of modern revolution to include systematical analysis of the development of modern revolutionary situations. Examination of the more important revolutions of modern times, including study of the historical events, testing of the methods of systematic analysis, with emphasis on revolutionary tactics, e.g., political terrorism.

NS3960 INTERNATIONAL LAW AND THE LAW OF WAR (4-0).
An introduction to the principles of international law including origins, sources, sovereignty, states, territory, jurisdiction, persons, treaties, settlement of disputes and the Law of the Sea. The law of war is analyzed as it is to be observed and enforced by the Armed Forces of the United States. Special attention is paid to the 1949 Geneva Convention, the Navy's Law of Naval Warfare and the Army's Law of Land Warfare.

NS3962 OCEAN, MARITIME AND TORT LAW FOR THE HYDROGRAPHIC COMMUNITY (4-0).
This course is designed to provide a detailed introduction to the personal and institutional liabilities and immunities of the hydrographic community. As such, it will consist of a general introduction to governmental tort law, including the applicable sections of the Federal Tort Claims Act and pertinent cases; relevant areas of Admiralty law and international law, both public and private, as it applies to the rights and duties pertaining to access to and use of both international and sovereign waters. In addition, special emphasis will be given to the historical and legal developments of the law of the sea; and to present day trends in international conventions leading up to the law of the Sea Treaty.

NS4030 SPECIAL TOPICS IN NATIONAL SECURITY POLICY (4-0).
Each quarter of the academic year a seminar is held on a special topic relating to current problems and issues. The list of topics for the seminar is announced prior to the fall quarter each year. Advanced study and research is conducted on topics not covered in other seminars. A major, graded research paper is required. PREQUISITE: Permission of the instructor.

NS4079 ADVANCED DIRECTED STUDIES IN NATIONAL SECURITY AFFAIRS (Credit open 1-0 to 4-0) (V-0).
Format and content vary. Normally involves extensive individual research under direction of the Instructor and submission of a substantial paper of graduate seminar quality and scope.

NS4152 PROBLEMS OF INTELLIGENCE AND THREAT ANALYSIS (4-0).
This advanced course focuses on problems in analyzing the intentions and capabilities of a military competitor, especially the Soviet Union. This course is specifically intended to draw on the knowledge and experience of practitioners and analysts in the Naval intelligence community. Students will be given the opportunity to undertake analyses where they apply methods and concepts acquired in earlier courses. PREREQUISITES: NS3150 or NS3154 or permission of the instructor; TOP SECRET clearance with eligibility for SPECIAL INTELLIGENCE information.

NS4159 SEMINAR: ADVANCED TOPICS IN OPERATIONAL INTELLIGENCE (4-0).
Application of concepts, principles and methods studied in all previous courses. Use of computer decision-support systems, operations analysis methods, intelligence products, threat assessment processes and wargaming facilities in illustrative cases from global war to assassinations. Knowledge of U.S. and potential adversaries' military capabilities, strategies and tactics required. PREREQUISITES: NS3159, TOP SECRET clearance with eligibility for SPECIAL INTELLIGENCE information.

NS4179 ADVANCED DIRECTED STUDIES: INTELLIGENCE (Credit open) (V-0).
Format and content vary. Normally involves extensive individual research under the direction of the instructor and submission of a substantial paper of graduate quality and scope.

NS4230 SEMINAR IN STRATEGIC PLANNING (4-0).
Advanced study in the concept and methods of strategic planning and analysis, particularly with respect to iterative aggregation and synthesis in the Military Department, the Joint Chiefs of Staff, the Office of the Secretary of Defense, the Department of State, the National Security Council/White House and the Congress. Students are expected to research and report on a major strategic issue/ strategic planning process/case study which has/had a significant long-term impact. PREREQUISITES: SECRET clearance and NS3230 or permission of instructor.

NS4250 PROBLEMS OF SECURITY ASSISTANCE AND ARMS TRANSFER (4-0).
An analysis of the patterns, purposes and effects of cross-national security assistance, including arms sales and the transfer of technology. Special topics include: factors dominating the arms transfer policies of the major powers; the role of the military attache; the design, execution and evaluation of security assistance programs. PREREQUISITE: NS3030 or NS3020.

NS4253 TECHNOLOGY AND STRATEGIC PLANNING (4-0).
This course is intended to develop an understanding of the interrelationship of technology and strategic planning. Issues include problems in assessing the military value of new technology, technological risk, controversy and affordability, institutional impediments to innovation and a strategy for long range technology investments. Topics include historical case studies of innovation, the assessment of strategic force survivability and current topics such as ballistic missile defense, the role of space technology, smart/brilliant missiles and the strategy and technology for the Navy of the 21st century. SECRET clearance required.

NS4261 SURVEY OF STRATEGIC STUDIES (4-0).
An extensive survey of the classical and contemporary literature on strategic thinking: national objectives and strategic alternatives; deterrence, counterforce, arms control, counter insurgency, compellence; components and rules of the international strategic system; arms competitions, nuclear proliferation, terrorism. Student projects on current strategic problems are a major component of the course. PREREQUISITE: NS3020.

NS4279 ADVANCED DIRECTED STUDIES: STRATEGIC PLANNING (Variable credit) (V-0).
Format and content vary. Normally involves extensive individual research under direction of the instructor and submission of a substantial paper of graduate seminar quality and scope.

NS4280 ADVANCED TOPICS IN NUCLEAR STRATEGY AND DETERRENCE (4-0).
A follow-up course to NS3280 that examines advanced issues in nuclear strategy, strategic and crisis stability and deterrence. In addition to advanced theoretical issues of deterrence, this course will specifically investigate the role and importance of nuclear force planning and strategy formulation in deterrence, stability and foreign policy implementation. Some of this analysis will be done using both static measurement models and dynamic computer nuclear exchange modeling. PREREQUISITES: NS3280 or permission of the instructor; SECRET clearance.

NS4300 SEMINAR IN MIDDLE EASTERN CIVILIZATION (4-0).
Description and analysis of the four major cultural traditions of the Middle East: Arabic, Persian, Judaic and Turkish. Students read translations of selected classical and contemporary writings from each of these traditions and secondary materials concerning social and cultural institutions. PREREQUISITE: NS3310 or NS3300 or consent of instructor.

NS4310 SEMINAR IN SECURITY PROBLEMS OF THE MIDDLE EAST (4-0).
Advanced Middle Eastern politics and the security problems they present to the U.S. decision makers. The central theme of the course is U.S. interests in the Middle East, how these interests are threatened and what policy alternatives have been proposed to secure them. PREREQUISITE: NS3310 or NS3320.

NS4410 SOVIET SECURITY PROBLEMS (4-0).
An advanced seminar giving students an opportunity to engage in discussion and research on Soviet national security problems. The focus is on the relationship between military power and national security, political stability and reform, Sino-Soviet and Soviet-American relations, and science and technology policy. PREREQUISITE: NS3400, or NS3401, or NS3410, or NS3450, or permission of instructor.

NS4451 ADVANCED TOPICS IN SOVIET NAVAL AFFAIRS (4-0).
Advanced study and research in Soviet naval and maritime affairs Topics include: decision-making processes, scenarios, warfare capabilities and support systems, missions methodology, gaming and U.S. Soviet naval interactions. PREREQUISITE: NS3452, TOP SECRET clearance with eligibility for SPECIAL INTELLIGENCE information, or permission of instructor.

NS4500 SEMINAR IN THE NATIONAL INTEREST (4-0).
An advanced study of the underlying assumptions and objectives of American security and foreign policy. The core of the course is an in-depth analysis of the American national interest in the international context. Students are required to write a major seminar paper on American national interests in a specific country or region.

NS4510 SEMINAR IN GOVERNMENT AND POLITICS IN LATIN AMERICA (4-0).
This seminar will consist of intensive readings of advanced topics in Latin American politics and government, including the interplay between economic, political, military and social factors in the process of political change at play in the region. Students will be required to prepare classroom lectures on selected subjects and present an article length paper on a separate topic. Reading assignments will be extensive, which presupposes a significant level of knowledge and preparation prior to the course. PREREQUISITES: NS3510, 3520, 3540 and 3550.

NS4560 SEMINAR IN INTERNATIONAL SECURITY PROBLEMS OF LATIN AMERICA (4-0).
Reviews the history of Latin America as part of an inter-American system and the case of joint foreign policy action on economic, political and military fronts. Case studies draw attention to the role of the United States in the region, both within the formal regional institutions and in bilateral relations including military advisor activities. The relations are put in the context of the attitudes of Latin American leaders toward hemispheric solidarity.

NS4660 ASIA IN WORLD AFFAIRS (4-0).
Advanced study of Asia's contemporary economic, security, diplomatic, and cultural roles in world affairs, with special emphasis upon policy interaction of China, Japan, India and other key states with the US, USSR, Western Europe and the non-Asian third world.

NS4690 INTERNATIONAL SECURITY PROBLEMS OF ASIA AND THE ADJACENT OCEANS (4-0).
Advanced study of Asian security issues with special emphasis on the balance of forces, regional and external alliances, prospects for conflict and Asian concepts of security and strategy. PREREQUISITE: Consent of instructor.

NS4710 SEMINAR IN POLITICAL AND SECURITY PROBLEMS OF EUROPE (4-0). A research seminar on political and security issues in contemporary Europe. Students conduct and present original research on a selected issue, or related issues, in specific European countries or sub-regions. The issue around which the seminar is structured varies from term to term. It is chosen to meet the research interests of each group of students enrolled in the course.

NS4720 SEMINAR IN SOVIET-EUROPEAN RELATIONS (4-0).
A seminar intended to deepen the student's knowledge of current issues in Soviet and European affairs.

NS4900 SEMINAR IN INTERNATIONAL NEGOTIATIONS (4-0).
Advanced study and research in the international negotiating process, designed to provide students with an opportunity to analyze specific topics related to negotiating national security.

NS4901 SEMINAR IN OCEAN POLICY (4-0).
An advanced consideration of ocean policy issues and problems. Emphasis in on legal, political, military and oceanographic matters in the context of the Law of the Sea and the new U.S. National Oceans Policy.

NS4902 SEMINAR ON MODERN REVOLUTION AND TERRORISM (4-0).
A research seminar on modern revolution and terrorism. Students will be introduced to the general sources of information and accomplish the research necessary to complete a seminar paper in a related area of their choice. PREREQUISITE: NS3902.

NS4950 SEMINAR IN ARMS CONTROL AND NATIONAL SECURITY (4-0).
An analysis of international negotiation processes as related to the control of armaments, including a review of the history of modern arms control efforts, examination of the domestic political context of arms limitation, the implications of international law relevant to treaty negotiations, ratification and enforcement, the intellectual contributions of scientists to the development of arms control theory and a review of selected substantive issues with respect to security concerns, verification capabilities and compliance measures. PREREQUISITES: NS3450 and NS3900 or consent of instructor and SECRET clearance.

DEPARTMENT OF OCEANOGRAPHY

Mary Louise Batteen, Associate Professor (1985)*; PhD, Oregon State University, 1984.

Robert Hathaway Bourke, Associate Dean of Faculty and Graduate Studies, Professor (1971); PhD, Oregon State University, 1972.

Everett Carter, Assistant Professor (1990); PhD, Harvard University, 1986.

Ching-Sang Chiu, Assistant Professor (1988); ScD, Massachusetts Institute of Technology and Woods Hole Oceanographic Institution, 1985.

Pecheng Chu, Adjunct Research Professor (1986); PhD, University of Chicago, 1985.

James R. Clynch, Adjunct Research Professor (1990); PhD, Brown University, 1974.

Curtis Allan Collins, Chairman and Professor (1987); PhD, Oregon State University, 1967.

Nicholas Dodd, Adjunct Research Professor (1987); PhD, University of Bristol, 1987.

Newell Garfield, III, Adjunct Research Professor (1989); PhD, University of Rhode Island, 1989.

Roland William Garwood, Professor (1976); PhD, University of Washington, 1976.

Eugene Clinton Haderlie, Adjunct Distinguished Professor Emeritus (1965); PhD, University of California at Berkeley, 1950.

Glenn Harold Jung, Professor Emeritus (1958); Texas A & M University, 1955.

Dale Fredrick Leipper, Professor Emeritus (1968); PhD, Scripps Institution of Oceanography, 1950.

John L. Newton, Adjunct Research Professor (1990); PhD, University of Washington, 1973.

Jeffrey Aaron Nystuen, Assistant Professor (1986); PhD, Scripps Institution of Oceanography, 1985.

Robert George Paquette, Adjunct Professor Emeritus (1971); PhD, University of Washington, 1941.

Steven Richard Ramp, Assistant Professor (1986); PhD, University of Rhode Island, 1986.

Felix Michael Reynolds, Commander, U.S. Navy; Instructor (1989); MS, Naval Postgradute School, 1976.

Leslie K. Rosenfeld, Adjunct Research Professor (1989); PhD, Woods Hole Oceanographic Institution, 1987.

Chairman:
Curtis A. Collins,
Professor,
Code OC/Co, Spanagel Hall,
Room 350,
(408) 646-2673,
AV 878-2673.

Associate Chairmen:

Research
Edward B. Thornton,
Professor,
Code OC/Tm, Spanagel Hall,
Room 327,
(408) 646-2847,
AV 878-2847.

Instruction
Roland W. Garwood, Jr.,
Professor,
Code OC/Gd, Spanagel Hall,
Room 308,
(408) 646-3260,
AV 878-3260.

Mapping Charting and Geodesy
Joseph J. von Schwind,
Associate Professor,
Code OC/Vs, Building 224
Room 106,
(408) 646-3271,
AV 878-3271.

Kurt John Schnebele, Captain, NOAA; Assistant Professor (1987); MS, Naval Postgraduate School, 1979.

Albert Julius Semtner, Professor (1986); PhD, Princeton University, 1973.

David Clement Smith, IV, Assistant Professor (1985); PhD, Texas A & M University, 1980.

Timothy Peter Stanton, Adjunct Research Professor (1978); MS, University of Auckland, 1977.

Warren Charles Thompson, Professor Emeritus (1953); PhD, Texas A & M University, 1953.

Edward Bennett Thornton, Professor (1969); PhD, University of Florida, 1970.

Eugene Dewees Traganza, Professor Emeritus (1970); PhD, University of Miami, 1966.

Stevens Parrington Tucker, Assistant Professor (1968); PhD, Oregon State University, 1972.

Joseph John von Schwind, Associate Professor (1967); PhD, Texas A & M University, 1968.

Jack B. Wickham, Professor Emeritus (1951); MS, Scripps Institution of Oceanography, 1949.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

The Oceanography Department primarily supports curricula sponsored by the Oceanographer of the Navy; viz, #373 Air-Ocean Science, #374 Operational Oceanography, #440 Oceanography, #441 Mapping, Charting and Geodesy.

The department focuses on Physical Oceanography including courses in Mapping, Charting and Geodesy (MC&G) in accordance with naval priorities.

In Physical Oceanography, topics include ocean dynamics, numerical ocean circulation modeling, satellite remote sensing of the ocean, air-sea interaction, Arctic oceanography, upper ocean dynamics and thermodynamics, near-shore processes, mesoscale dynamics, synoptic/mesoscale ocean prediction, coastal ocean circulation and environmental acoustics. The MC&G program includes hydrographic surveying, electronic navigation marine geodesy, photogrammetry, marine geophysics (bathymetry, gravity, magnetics), naval astronomy and precise time. The department also provides core courses for Naval Intelligence, ASW, Engineering Acoustics and the space curricula.

The Mapping, Charting and Geodesy Curriculum has International Hydrographic Organization-International Federation of Surveyor Category A Certification.

MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY

Entrance to a program leading to the degree Master of Science in Physical Oceanography requires a baccalaureate degree. Minimal requirements include mathematics through differential and integral calculus and one year of calculus-based physics.

The degree Master of Science in Physical Oceanography requires:

1) Completion of at least eight physical oceanography graduate courses with at least four courses in the OC4000 series. The entire sequence of courses selected must be approved by the Department of Oceanography. Significant educational experience at sea on a research vessel is required for the degree. (OC3570 satisfies this requirement).

2) Completion of an acceptable thesis on a topic approved by the Department of Oceanography.

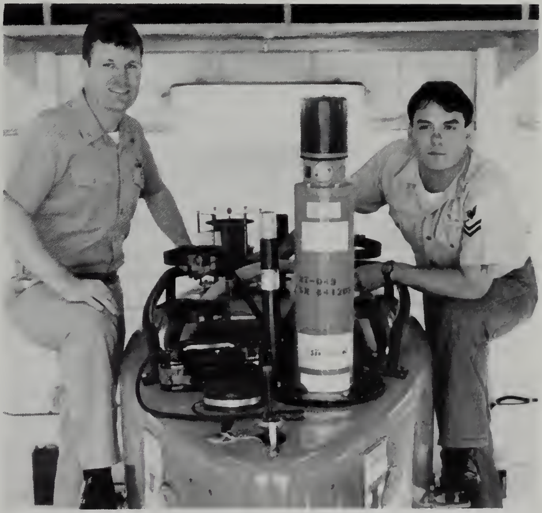
MASTER OF SCIENCE IN HYDROGRAPHIC SCIENCES

Entrance to a program leading to the degree Master of Science in Hydrographic Sciences requires a baccalaureate degree. Minimal requirements include mathematics through differential and integral calculus and one year of calculus-based physics.

The degree Master of Science in Hydrographic Sciences requires:

1) Completion of forty-quarter hours of graduate courses in the GH series of which twelve hours must be at the 4000 level. The entire sequence of courses must be approved by the Department of Oceanography. Significant educational experience at sea on a research vessel is required for the degree. (GH3910 and GH3911 satisfy this requirement).

2) Completion of an acceptable thesis on a topic approved by the Department of Oceanography.



MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY

Direct entrance to a program leading to the degree Master of Science in Meteorology and Physical Oceanography requires a baccalaureate degree in one of the physical sciences, mathematics, or engineering. This normally permits the validation of a number of required undergraduate courses such as physics, differential equations, linear algebra, vector analysis and various courses in meteorology and/or oceanography, which are prerequisites to the graduate program. These prerequisites may be taken at the Naval Postgraduate School; however, in that event the program may be lengthened by one or more quarters.

The degree Master of Science in Meteorology and Physical Oceanography requires:

1) Necessary prerequisite courses in mathematics (through partial differential equations), meteorology and physical oceanography;

2) The sequence of core courses in meteorology and oceanography in the fields of dynamical, numerical and physical and synoptic meteorology and oceanography;

3) An approved selection of graduate elective courses in meteorology and oceanography;

4) A significant educational experience at sea or a research vessel.

5) An acceptable thesis on a topic approved by either department.

The total number of quarter hours in (2) and (3) above must be at least 48. These 48 hours must include 20 hours at the 4000 level in courses other than directed study and they should show an approximate balance between the disciplines of Meteorology and Physical Oceanography.

DOCTOR OF PHILOSOPHY

Department of Oceanography admission requirements for the degree Doctor of Philosophy include:

1) A master's degree (or the equivalent) in one of the physical sciences, mathematics, or engineering or,

2) A bachelor's degree with a high QPR or,

3) A highly successful first graduate year in a Master's program, with clear evidence of research ability.

The Ph.D. Program is in Physical Oceanography, including areas of study in ocean circulation theory, air-sea interaction, ocean acoustics and nearshore oceanography among others.

To undertake doctoral work in oceanography, a student must apply to the Chairman, Department of Oceanography. A copy of the Oceanography Ph.D. Program Guidelines is available from the Department of Oceanography.

OCEANOGRAPHIC LABORATORIES

NPS is a member of UNOLS (University National Oceanography Laboratory System) and of CENCAL (Central California Cooperative). UNOLS operates the Nation's academic oceanographic research fleet, while CENCAL promoted and coordinates research vessel operations between several academic institutions in Central California. The nearby Moss Landing Marine Laboratory operates the NSF-owned, 135-foot R/V POINT SUR for the benefit of CENCAL, with NPS a major user.

A Physical Ocean Observation Laboratory (POOL) provides for instruction in the practical design, deployment and recovery of state-of-the-art oceanographic instrumentation. Real-time observations of currents, temperature, salinity and sound velocity structure in a variety of oceanic regimes are analyzed, applying theoretical and mathematical techniques learned in the classroom to Naval Oceanography problems.

NPS is also a member of UCAR (University Corporation for Atmosphere Research), which serves some of the computational and other research facility needs of the oceanographic community. Together with the Meteorology Department, the Oceanography Department operates the Interactive Digital Experimental Analysis Laboratory (IDEA), that is equipped with several workstations for the analysis of satellite images or other digital fields, e.g., numerical model output. In addition, the Department operates a 14-terminal color graphics instructional laboratory for simulation and analysis of oceanographic data.

COURSE OFFERINGS

GH3903 ELECTRONIC SURVEYING AND NAVIGATION (4-0).

Introduction to the theory and practice of electronic surveying and navigation including principles of electronics, electronic surveying systems and basic components, geometry of electronic surveying, ray path curvature, propagation velocity, and velocity applications to surveying. PREREQUISITE: Consent of instructor.

GH3910 HYDROGRAPHIC SURVEYING FIELD EXPERIENCE (2-9).

Students will conduct a basic hydrographic survey of a portion of Monterey Bay. Field work consists of locating horizontal control stations through photogrammetric methods, installing and monitoring a tide gage, and running sounding lines using various types of positioning control. Data acquisition, reduction and presentation will be emphasized. PREREQUISITES: GH3906 and concurrent registration in GH3911.

GH3911 GEODETIC SURVEYING FIELD EXPERIENCE (1-5).

Students will conduct a geodetic survey project in the Monterey Bay area to support GH3910. Methods include triangulation, trilateration, traverse, resection and intersection. Azimuth determination by observation on Polaris. PREREQUISITES: GH3906 and concurrent registration in GH3910.

GH3950 NAVAL ASTRONOMY AND PRECISE TIME (2-0).

Positional astronomy. Coordinate systems. Solar system dynamics. Astrometry (measurements of positions and motions of stars). Time, earth rotation and atomic clocks. Naval applications of astronomy. Overview of astrophysics and cosmology. PREREQUISITES: College physics and calculus.

GH4800 ADVANCED TOPICS IN GEODETIC SCIENCE (Variable hours 1-0 to 4-0) (V-0).

Advanced topics in various aspects of the geodetic science. Topics not covered in regularly offered courses. The course may be repeated for credit as topics change. PREREQUISITES: Consent of the department Chairman and instructor.

GH4906 GEOMETRIC AND ASTRONOMIC GEODESY (4-0).
Properties of the ellipsoid, geometric aspects of geodesy including triangulation, trilateration, traverse, and leveling techniques and instrumentation; datum transformation, astronomic determination of latitude, longitude, and azimuth; time and astronomic instrumentation. PREREQUISITE: Consent of instructor.

GH4907 GRAVIMETRIC AND SATELLITE GEODESY (4-0).
Potential theory as applied to the gravity field of the earth; application of Stokes' Formula, integral, and function; deflection of the vertical; gravimetric reduction; geometric and dynamic applications of satellites, orbital geometry and satellite orbit dynamics. PREREQUISITE: GH4906.

OC0810 THESIS RESEARCH (0-0).
Every student conducting research in Oceanography will enroll in thi course.

OC0999 THESIS SEMINARS (NO CREDIT). (2-0).
Students in the various oceanography curricula present their thesis research. PREREQUISITE: Preparation of a thesis.

OC2001 OCEAN SYSTEMS (4-0).
This course is designed to support the Naval Intelligence Curriculum by providing an overview of significant oceanographic factors, data networks and their products, sound propagation in the ocean, active and passive sonar and ocean vehicle design practices.

OC2020 COMPUTER COMPUTATIONS IN AIR-OCEAN SCIENCES (1-2).
Introduction to FORTRAN, and the NPS mainframe computer, as applied to elementary problems in oceanography and meteorology. PREREQUISITES: Calculus and college physics.

SEARCH · RESCUE · RECOVERY

OC2120 SURVEY OF OCEANOGRAPHY (4-0).
An integrated view of the whole field of oceanography including physical, biological, geological and other chemical aspects. PREREQUISITES: None.

OC2520 SURVEY OF AIR-OCEAN REMOTE SENSING (3-0).
Overview of systems of remote sensing of the atmosphere and oceans from space, and operational applications. PREREQUISITES: Undergraduate physics and calculus, or consent of Instructor.

OC3120 BIOGEOCHEMICAL PROCESSES IN THE OCEAN (4-3).
Basic biological, geological, and chemical processes in the ocean. Bioacoustics, deep scattering layers, and bio-deterioration. Geomorphic features of the ocean floor; kinds and distribution of ocean bottom features. Chemical composition of the ocean.

OC3140 PROBABILITY AND STATISTICS FOR AIR-OCEAN SCIENCE (3-2).

Basic probability and statistics, in the Air-Ocean Science context. Techniques of statistical data analysis. Structure of a probability model, density distribution function, expectation, and variance. Binomial, Poison and Gaussian distributions. Conditional probability and independence. Joint distributions, covariance and central limit theorem. Transformations of random variables. Histograms and empirical distributions and associated characteristics such as moments and percentiles. Standard tests of hypotheses and confidence intervals for both one- and two-parameter situations. Regression analysis as related to least squares estimation. PREREQUISITE: Calculus.

OC3150 ANALYSIS OF AIR OCEAN TIME SERIES (3-2).

Analysis methods for atmospheric and oceanic time series. Furrier transforms applied to linear systems and discrete data. Correlation functions, power density spectra and cospectra. Optimal design of air-ocean data network. Laboratory work involves analysis of actual atmospheric and ocean time series using principles developed in class. PREREQUISITES: MA3132 and a probability and statistics course.

OC3210 POLAR OCEANOGRAPHY (3-0).

Covers the ice characteristics and physical oceanography of polar seas. Sea ice: types, physical and mechanical properties, heat flux, temporal and spatial distribution, melting and freezing processes, forecasting models and remote sensing of ice/snow covered surfaces. Physical oceanography of currents and water masses, deep and bottom water formation, fronts and eddies, polyna processes and underwater acoustics. Naval and research operations in polar warfare. PREREQUISITE: OC3240

OC3212 POLAR METEOROLOGY/OCEANOGRAPHY (4-0).

Operational aspects of Arctic and Antarctic meteorology. Polar oceanography. Sea ice amount, seasonal distribution, melting and freezing processes, physical and mechanical properties, drift and predictions. PREREQUISITES: MR3222 and OC3240 or consent of instructor.

OC3230 DESCRIPTIVE PHYSICAL OCEANOGRAPHY (3-1).

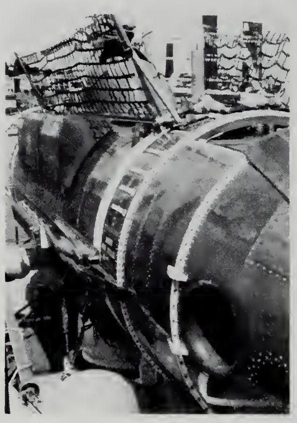
Physical properties of seawater. Processes influencing the distribution of heat, salt and density in the ocean. Static stability in the ocean. Circulation and water masses in the ocean. Laboratory work involves collection and analysis of actual data using principles developed in class. PREREQUISITE: MR/OC2020 or the equivalent (may be concurrent).

OC3240 OCEAN DYNAMICS I (4-2).

Application of dynamical concepts of ocean circulation, including conservation of mass, momentum and energy. Oceanic currents without friction: inertial and geostrophic flows. Frictional currents: Reynolds equations, Ekman and wind-driven flows. Vorticity balance: Sverdrup transport, potential vorticity, topographic steering, western intensification, and Rossby waves. Thermohaline effects and thermocline theory. PREREQUISITES: OC3230 and OC3321 or the equivalent.

OC3260 SOUND IN THE OCEAN (4-0).

The fundamentals of ocean acoustics including the acoustic wave equation, ray tracing, acoustic arrays and filters, ambient noise, scattering, absorption and an introduction to normal mode theory. Examples from acoustical oceanography including ocean tomography, flow visualization and acoustic probing of the ocean surface and bottom. PREREQUISITES: OC3230 and MA3132 or equivalent.



OC3261 OCEANIC FACTORS IN UNDERWATER SOUND (4-2).

Examines the oceanic factors which influence sound propagation in the ocean and the effects in acoustic forecasting. Factors considered include temporal and spatial variations in sound speed profiles, ambient noise, biological effects, reflection characteristics of ocean surface and bottom, signal fluctuations, and forecasting ocean thermal structure, transmission loss, ambient noise and reverberation. This course is designed for the Engineering Acoustics Curriculum. PREREQUISITE: PH3452.

OC3266 OPERATIONAL ACOUSTIC FORECASTING (2-2).

Couse emphasizes tactical use of the environment as a force multiplier in acoustic ASW. Tactical guides involving ducts, fronts, eddies and bottom structure are examined in range-dependent propagation loss mode. Emerging tactics using LFA, VLF and Fixed Distributed systems and non-acoustic methods are reviewed. PREREQUISITES: OC3260, SECRET NOFORN clearance.

OC3321 AIR-OCEAN FLUID DYNAMICS (4-0).

The hydrodynamical equations for rotating stratified fluids. Forces, kinematics, boundary conditions, scale analysis. Simple balanced flows, baroclinicity, thermal wind, vorticity and divergence; rotational and divergent part of the wind; circulation theorem. PREREQUISITE: MA2047.

OC3325 MARINE GEOPHYSICS (3-0).

Theory and methods of marine geophysics surveys, and emphasis on gravity, magnetism, seismic and acoustic wave propagation; geophysical anomalies associated with major seafloor features; marine geodesy. PREREQUISITE: MR2121 (may be concurrent).

OC3445 OCEANIC AND ATMOSPHERIC OBSERVATIONAL SYSTEMS (2-2).

Principles of measurement; sensors, data acquisition systems, calibration, etc. Methods of measurement for thermodynamic and dynamic variables in the ocean and atmosphere, including acoustics and optics. PREREQUISITES: OC3230 and MR3420, MR/OC3150 or consent of instructor.

OC3520 REMOTE SENSING OF THE ATMOSPHERE AND OCEAN (4-0).

Principles of radiative transfer and satellite sensors and systems; visual, infrared and microwave radiometry, and radar systems; application of satellite remotely sensed data in the measurement of atmospheric and oceanic variability. PREREQUISITES: Undergraduate physics and differential/integral calculus; ordinary differential equations or consent of instructor.

OC3522 REMOTE SENSING OF THE ATMOSPHERE AND OCEAN/LABORATORY (4-2).
Same as OC3520 plus laboratory sessions on the concepts considered in the lecture series. PREREQUISITES: Same as OC3520.

OC3570 OPERATIONAL OCEANOGRAPHY / METEOROLOGY (2-4).
Experience at sea acquiring and analyzing oceanographic and atmospheric data using state of the art instrumentation. Integration of satellite remote sensing and other operational products with in-situ data. Includes survey of instrumentation, pre-cruise planning, operations at sea, and post-cruise analysis. PREREQUISITE: OC3240 or MR3220 or consent of instructor.

OC3610 WAVE AND SURF FORECASTING (2-2).
Theory and prediction of wind-generated ocean waves. Spectral transformation of waves from deep to shallow water. Prediction of surf and wave related influences on operations. PREREQUISITES: OC3150 and OC4211.

OC4211 OCEAN DYNAMICS II (4-0).
Linear theory of surface, internal, inertial-internal and Rossby waves. Coastal and equatorial trapped waves. PREREQUISITES: MA3132 and OC3240.

OC4212 TIDES (4-0).
Development of the theory of tides including the tide-producing forces, equilibrium tides, and the dynamic theory of tides; harmonic analysis and prediction of tides; tidal datum planes and their relationship with geodetic datum planes, short-term and secular changes in sea level. PREREQUISITE: OC3130 or OC4211.

OC4213 NEARSHORE AND WAVE PROCESSES (3-1).
Shoal-water wave processes, breakers and surf; nearshore water circulation; beach characteristics; littoral drift; coastal hydraulics; storm surge. PREREQUISITE: OC4211 or consent of instructor.

OC4220 COASTAL OCEANOGRAPHY (4-1).
Coastal ocean physical processes. Dynamics and models of coastal ocean circulations driven by wind, thermohaline, tidal, boundary currents and ocean eddy forces. Recent papers on coastal ocean circulation. Laboratory sessions on computing properties of coastal trapped waves and wind-driven motions over the shelf and slope. PREREQUISITE: OC4211.

OC4250 GENERAL CIRCULATION OF THE ATMOSPHERE AND OCEANS (3-0).
Selected topics on the general circulation of the atmosphere (e.g. heat, momentum and moisture fluxes; energetics) and ocean (e.g. linear and non-linear theories of the wind-driven ocean circulation); coupled ocean-atmosphere general circulation models. PREREQUISITE: Consent of instructor.

OC4262 THEORIES & MODELS IN UNDERWATER ACOUSTICS (3-0).
The second in a three-course sequence of underwater acoustics courses. Development of the underlying theories and algorithms of ray, normal mode, and parabolic equation acoustic models for both range independent and dependent environments. Examination of the strengths and weaknesses of and similarities between the various models. PREREQUISITES: OC3260, and MA3132 or equivalent.

OC4264 OCEAN ACOUSTIC PREDICTION (3-2).
The third in a three course sequence of underwater acoustics courses. Examines the temporal and spatial influence of oceanic viability on underwater sound propagation and ambient noise. Emphases on empirically derived quantities representative of all oceanic area and seasons. Operational prediction models of transmission loss, ambient noise, and reverberation are described and used in laboratory exercises to evaluate sonar performance. PREREQUISITE: OC3260.

OC4267 OCEAN INFLUENCES AND PREDICTION: UNDERWATER ACOUSTICS (4-2).
Examines sound speed profiles (time and space variability), ambient noise, absorption, and reflection from the sea surface and bottom as they affect sound propagation in the ocean. Synoptic prediction techniques for ambient noise and transmission loss are reviewed. Environmental data input and computational approximations for acoustic models are evaluated against observed signal fluctuations and transmission loss. The course is designed for the Air-Ocean Science, Operational Oceanography, and ASW Curricula. PREREQUISITES: OC2120 and OC3260.

OC4323 NUMERICAL AIR AND OCEAN MODELING (4-2).
Numerical models of atmospheric and oceanic phenomena. Finite difference techniques for solving elliptic and hyperbolic equations, linear and non-linear computational instability. Spectral and finite element models. Filtered and primitive equation prediction models. Sigma coordinates. Objective analysis and initialization. Moisture and heating as time permits. PREREQUISITES: MR4322 or OC4211, MA3132; MA3232 desirable.

OC4324 ADVANCED NUMERICAL OCEAN MODELING (3-0).
Advanced techniques for simulating and predicting ocean circulation, including recent modeling results. Topics to include multi-layer guasi-geotrophic models, multi-level primitive equation models, treatment of irregular geometry and open boundary conditions, satellite data assimilation and computer technology considerations. PREREQUISITES: MR/OC 4323.

OC4331 MESOSCALE OCEAN VARIABILITY (4-0).
Contemporary knowledge of ocean mesoscale eddies, fronts, meandering currents; baroclinic and barotropic instabilities; kinematics, dynamics and energetics from observations, theories and models. PREREQUISITE: OC4211.

OC4335 ELEMENTS OF OCEAN PREDICTION (3-2).
Analyze, forecast, and interpret synoptic information on mesoscale, synoptic scale, and large scale processes on a regional basis. Use is made of dynamical and statistical principles and methods and of diagnostic and prognostic models. PREREQUISITES: OC4330 and MR/OC4323 (may be concurrent).

OC4413 AIR/SEA INTERACTION (4-1).
Fundamental concepts in turbulence. The atmospheric planetary boundary layer, including surface layer, and bulk formulae for estimating air-sea fluxes. The oceanic planetary boundary layer including the dynamics of the well-mixed surface layer. Recent papers on large-scale air-sea interaction. PREREQUISITE: MR/OC3150, OC3240 or MR4322, or consent of instructor.

OC4414 ADVANCED AIR/SEA INTERACTION (3-0).
Advanced topics in the dynamics of the atmospheric and oceanic planetary boundary layers. PREREQUISITE: MR/OC4413 or consent of instructor.

OC4415 OCEAN TURBULENCE (3-0).
Advanced topics in the dynamics of ocean turbulence, wakes and microstructure. PREREQUISITE: MR/OC4413 or consent of instructor.

OC4490 OCEAN ACOUSTIC TOMOGRAPHY (EC/OC4490, same as EC4490) (3-0).
An introduction to Ocean Tomography, an underwater acoustic inverse technique for mapping ocean sound speed and current fields. Covers the major aspects of Ocean Acoustic Tomography, including the underlying concepts, the design and transmission of tomographic signals, and linear inverse methods for the reconstruction of ocean fields. PREREQUISITES: OC3260 or EC3450 or PH4453 or equivalent; MA2042 and MA3132 or equivalent.

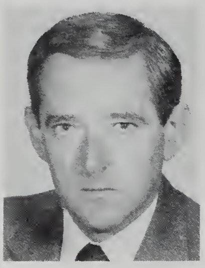
OC4520 TOPICS IN SATELLITE REMOTE SENSING (3-0).
Selected topics in the advanced application of satellite remote sensing to the measurement of atmospheric and oceanic variables. PREREQUISITE: MR/OC3522.

OC4610 SOVIET OCEANOGRAPHY (3-0).
Soviet civilian and naval oceanography program including centers, research vessels, instrumentation, remote sensing, numerical modeling and current ocean research areas. Relation to naval strategy and operations. Recent Soviet papers. PREREQUISITES: OC3240 or consent of instructor and SECRET NOFORN clearance.

OC4800 ADVANCED COURSES IN OCEANOGRAPHY (Variable hours 1-0 to 4-0) (V-).
Advanced courses in various aspects of oceanography. Typically these are advanced topics not covered in regularly offered courses. The course may be repeated for credit as topics change. PREREQUISITES: Consent of the department Chairman and instructor.

OC4900 DIRECTED STUDY IN OCEANOGRAPHY (V-0).
Independent study of advanced topics in oceanography. PREREQUISITES: Consent of the department Chairman and instructor. Graded on Pass/Fail basis only.

DEPARTMENT OF OPERATIONS RESEARCH



Chairman:
Peter Purdue,
Professor,
Code OR, Root Hall,
Room 272,
(408) 646-2381,
AV 878-2381.

Associate Chairmen:

Operations
Thomas E. Halwachs,
Instructor,
Code OR/Ha, Root Hall,
Room 265,
(408) 646-2413,
AV 878-2413.

Research
Robert R. Read,
Professor,
Code OR/Re, Root Hall,
Room 259,
(408) 646-2382,
AV 878-2382.

Instruction
James D. Esary,
Professor,
Code OR/Ey, Root Hall,
Room 273,
(408) 646-2780,
AV 878-2780.

Michael Page Bailey, Assistant Professor (1988)*; PhD, University of North Carolina, 1988.

Paul Bloch, Captain, U.S. Navy; Chair of Tactical Analysis (1989); MS, Naval Postgraduate School, 1975.

Dan Calvin Boger, Associate Professor (1979); PhD, University of California at Berkeley, 1979.

Gordon Hoover Bradley, Professor (1973); PhD, Northwestern University, 1967.

Gerald Gerard Brown, Professor (1973); PhD, University of California at Los Angeles, 1974.

William Caldwell, Lieutenant Colonel, U.S. Army; Instructor (1989); MS, Naval Postgraduate School, 1981.

James Norfleet Eagle, II, Associate Dean of Faculty and Graduate Studies, Associate Professor (1982); PhD, Stanford University, 1975.

James Daniel Esary, Professor (1970); PhD, University of California at Berkeley, 1957.

Robert Neagle Forrest, Professor (1964); PhD, University of Oregon, 1959.

Donald Paul Gaver, Jr., Distinguished Professor (1970); PhD, Princeton University, 1956.

Thomas Eugene Halwachs, Commander, U.S. Navy; Director of Wargaming (1988); MS, Naval Postgraduate School, 1976.

Thomas Harry Hoivik, Captain, U.S. Navy; Chair of Applied Systems Analysis (1987); MS, Naval Postgraduate School, 1973.

Gilbert Thoreau Howard, Associate Professor and Director of Research Administration (1967); PhD, Johns Hopkins University, 1967.

Wayne Philo Hughes, Jr., Adjunct Professor (1979); MS, Naval Postgraduate School, 1964.

Patricia Anne Jacobs, Professor (1978); PhD, Northwestern University, 1973.

Laura Derelle Johnson, Assistant Professor (1987); PhD, University of California at Berkeley, 1983.

William Glenn Kemple, Assistant Professor (1990); PhD, University of California at Riverside, 1985.

Harold Joseph Larson, Professor (1962); PhD, Iowa State University, 1960.

Siriphong Lawphongpaich, Assistant Professor (1987); PhD, University of Florida, 1983.

Peter Adrian Walter Lewis, Distinguished Professor (1971); PhD, University of London, 1964.

Judith Harris Lind, Adjunct Professor (1985); MS, Naval Postgraduate School, 1985.

Glenn Frank Lindsay, Associate Professor (1965); PhD, Ohio State University, 1966.

Kneale Thomas Marshall, Professor (1968); PhD, University of California at Berkeley, 1966.

Alan Wayne McMasters, Professor (1965); PhD, University of California at Berkeley, 1966.

Paul Robert Milch, Professor (1963); PhD, Stanford University, 1966.

Thomas Mitchell, Lieutenant Commander, U.S. Navy; Assistant Professor (1986); PhD, University of Georgia, 1979.

Samuel Howard Parry, Associate Professor (1964); PhD, Ohio State University, 1971.

Gary Kent Poock, Professor (1967); PhD, University of Michigan, 1967.

Peter Purdue, Chairman and Professor (1986); PhD, Purdue University, 1972.

Robert Richard Read, Professor (1961); PhD, University of California at Berkeley, 1957.

Victor W. Roeske, Major, U.S. Army; Instructor (1989); MS, Rensselaer Polytechnic Institute, 1982.

Richard Edwin Rosenthal, Professor (1985); PhD, Georgia Institute of Technology, 1975.

David Alan Schrady, Professor (1965); PhD, Case Institute of Technology, 1965.

Bruno Otto Shubert, Associate Professor (1969); PhD, Stanford University, 1968.

So Young Sohn, Assistant Professor (1990); PhD, University of Pittsburgh, 1989.

Michael Graham Sovereign, Professor (1970); PhD, Purdue University, 1965.

James Grover Taylor, Professor (1968); PhD, Stanford University, 1966.

Eric S. Theise, Assistant Professor (1990); PhD, Northwestern University, 1988.

David Barry Wadsworth, Commander, U.S. Navy; Instructor (1988); MS, Naval Postgraduate School, 1985.

William John Walsh, Lieutenant Commander, U.S. Navy; Instructor (1987); MS, Naval Postgraduate School, 1985.

Alan Robert Washburn, Professor (1970); PhD, Carnegie Institute of Technology, 1965.

Lyn R. Whitaker, Assistant Professor (1988); PhD, University of California, Davis 1985.

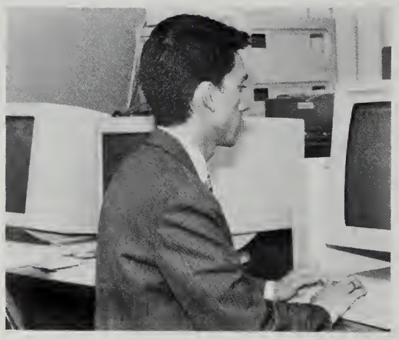
Roger Kevin Wood, Associate Professor (1982); PhD, University of California at Berkeley, 1982.

Walter Max Woods, Professor (1962); PhD, Stanford University, 1961.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

The Operations Research Department was founded in 1961 primarily to service students in the rapidly expanding OA (360) Curriculum. Graduates of that curriculum receive the Master of Science in Operations Research degree, as will graduates of the recently inaugurated Operational Logistics (361) Curriculum. The department consists of approximately forty faculty located in Root Hall. The department operates three laboratories: the Man/Machine Systems Design Lab on the first floor of Root Hall, the Wargaming Lab in Ingersoll Hall and the Microcomputer Lab in Ro-262.

In addition to being the primary department for the 360 and 361 curricula, the Operations Research Department also provides an extensive sequence of service courses for students in other curricula and is charged with teaching all probability and statistics courses at NPS. Nearly half of the department's teaching effort is devoted to these courses.



Active research areas within the department include statistics, stochastic processes, mathematical programming, human factors, wargaming, simulation, combat models, logistic systems and the study of Soviet military operations research.

MASTER OF SCIENCE IN APPLIED SCIENCE

Students with acceptable academic backgrounds may enter a program leading to a degree in Applied Science with a major in Operations Research. The program of each student seeking this degree must contain a minimum of 20-quarter hours in operations research at the graduate level, including work at the 4000 level. Additionally, the program must contain a minimum of 12-graduate quarter hours in an approved sequence of courses outside the Department of Operations Research. A total minimum of 12-quarter hours at the 4000 level plus an acceptable thesis is required. This program provides depth and diversity through specially arranged course sequences to meet the needs of the Navy and the interests of the individual. The department Chairman's approval is required for all programs leading to this degree. Applications to include this degree in dual master's programs will not be approved.

MASTER OF SCIENCE IN OPERATIONS RESEARCH

The degree Master of Science in Operations Research requires that:

1. A candidate shall previously have satisfied the requirements for the degree Bachelor of Science in Operations Research or the equivalent.

2. Completion of a minimum of 40-quarter hours of graduate level courses with:

    a. At least 18-quarter hours of 4000 level operations research/ systems analysis courses.

    b. An elective sequence approved by the Department of Operations Research.

    c. At least two but not more than three quarter courses devoted to a thesis. This credit shall not count toward the requirement as stated in (a) above.

3. Submission of an acceptable thesis on a subject previously approved by the Department of Operations Research.

The department offers the Ph.D. degree in Operations Research. The program begins with advanced coursework guided by the student's doctoral committee and leading to qualifying examinations in mathematical programming, statistics and stochastic processes, as well as completion of a minor field of study outside of operations research. The primary emphasis then shifts to the student's research program culminating in the Ph.D. dissertation.

Students wishing to enter directly into the doctoral program should write to the department Chairman. Applicants should include transcripts, Graduate Record Examination (or equivalent) scores and a brief statement of purpose. Detailed admission procedures may vary depending on the individual's location and position. However, in all cases the student must fulfill the general school requirements for the doctor's degree. Residency for this program generally requires 2-3 years beyond completion of a master's degree.

COURSE OFFERINGS

OA0001 SEMINAR FOR OPERATIONS ANALYSIS STUDENTS (No Credit) (0-2).

Guest lecturers. Review of experience tours. Thesis and research presentations.

OA0200 INTRODUCTION TO COMPUTATIONAL METHODS FOR OPERATIONS RESEARCH (No credit) (Meets last 6 weeks of quarter) (2-2).

Introduction to proper computer use methods with the NPS mainframe computer. Emphasis of the lectures is on fundamentals and conceptual entities of the computer system, including major building blocks and system limitations. Operating systems will be introduced, with emphasis on the IBM mainframe's VM/CMS system. Laboratories will stress proper use of the mainframe, including programming in REXX, document processing with GML and batch processing with the MVS system. PREREQUISITES: None.

OA0810 THESIS RESEARCH FOR OPERATIONS ANALYSIS STUDENTS (0-0).
Every student conducting thesis research will enroll in this course.

OA2200 COMPUTATIONAL METHODS FOR OPERATIONS RESEARCH I (3-2).
Introduction to computer usage with emphasis on computational methods particularly appropriate for operations research. Planning and structuring computer programs. Programming in FORTRAN. Use of text editor, disk files, subroutine libraries and debugging aids in timesharing mode on mainframe computers. Extensive project work coordinates growing student FORTRAN knowledge with topics in OR computing. Project topics may include numerical error analysis, probability distributions, random sampling, matrix computations, search methods and OR modeling. APL programming will be introduced as a final topic. PREREQUISITES: None.

OA2600 INTRODUCTION TO OPERATIONS ANALYSIS (4-0).
A first course in Operations Analysis, covering its origins in World War II to current practice. Introduces concepts, tools and methods of analysis, with tactical examples. Emphasis is on measuring combat effectiveness and developing better tactics. PREREQUISITES: None.

OA2900 WORKSHOP IN OPERATIONS RESEARCH / SYSTEMS ANALYSIS (Variable Credit) (V-0).
This course may be repeated for credit if course content changes. PREREQUISITE: Department approval. Graded on Pass/Fail basis only.

OA2910 SELECTED TOPICS IN OPERATIONS ANALYSIS (Variable hours 2-0 to 5-0) (V-0).
Presentation of a wide selection of topics from the current literature. This course may be repeated for credit if course content changes. PREREQUISITE: A background in operations research.

OA3101 PROBABILITY (4-1).
Probability axioms and event probability. Random variables and their probability distributions. Moment generating functions, moments and other distribution characteristics, distribution families. Functions of a random variable, including the probability integral transformation. PREREQUISITE: MA1117 or equivalent.

OA3102 PROBABILITY AND STATISTICS (4-1).
Jointly distributed random variables, independence and conditional distributions, covariance and correlation. Functions of several random variables, sampling distributions, limiting distributions, the central limit theorem, approximations. Order statistics, the t and f distributions, the bivariate normal distribution. Point estimation, properties of estimators. PREREQUISITES: OA2200, OA3101 and MA1118 or equivalent; MA3110 taken concurrently.

OA3103 STATISTICS (4-1).
Confidence intervals, hypothesis testing, regression, analysis of variance and nonparametric inference. Applications to reliability, test and evaluation and operations research problems. PREREQUISITE: OA3102 or equivalent.

OA3104 DATA ANALYSIS (3-1).
Techniques of analyzing, summarizing and comparing sets of real data. The exploratory nature of data analysis is featured through a variety of plotting methods and interactive work on computer terminals. Includes model building and the discovery and overcoming of shortcomings in data collected in actual situations. PREREQUISITE: OA3103.

OA3105 NONPARAMETRIC STATISTICS (4-0).
Tests based on the binomial distribution; confidence intervals for percentiles, tolerance intervals and goodness-of-fit tests; contingency tables; one sample tests, two sample tests and tests for independence based on ranks and scores; nonparametric analysis of variance and regression. Applications will illustrate the techniques. PREREQUISITE: A course in statistical inference.

OA3200 COMPUTATIONAL METHODS FOR OPERATIONS RESEARCH II (3-2).
A second course in computer programming, with emphasis on the use of a higher level programming language directed toward computational methods particularly appropriate to operations research. Primary emphasis on the planning and structuring of computer programs using FORTRAN - 77. Indepth analysis of proper program logic flow, program listings and debugging techniques. Introduction to mathematical and statistical subroutine libraries. Assigned projects involve file management, data structures, OR modelling, numerical analysis, data analysis, basic complexity analysis and computer simulation. PREREQUISITE: OA2200 or consent of the instructor.

OA3201 LINEAR PROGRAMMING (4-1).
Theory of optimization of linear functions subject to linear constraints. The simplex algorithm, duality, sensitivity analyses, parametric linear programming. Applications to resource allocation, manpower planning, transportation and communications, network models, ship scheduling, etc. Introduction to computer-based linear programming systems. PREREQUISITES: MA2042, MA3110 and OA3200.

OA3301 STOCHASTIC MODELS I (4-0).
The homogeneous and inhomogeneous Poisson processes, filtered and compound Poisson processes. Stationary Markov chains and their applications in modeling random phenomena. PREREQUISITE: OA3101 or consent of instructor.

OA3302 OA SYSTEM SIMULATION (4-0).
Discrete event digital simulation methodology. Monte Carlo techniques, use of FORTRAN and other available simulation languages. Variance reduction techniques, design of simulation experiments and analysis of results. PREREQUISITES: OA3200 or equivalent, OA3103 or equivalent, OA3301.

OA3401 HUMAN FACTORS IN SYSTEMS DESIGN I (4-0).
The human element in man-machine systems. Selected topics in human engineering and psychophysics with emphasis on their relation to military systems. Man-machine interface and man's motor and sensory capacities. PREREQUISITE: A course in statistics.

OA3402 HUMAN FACTORS IN SYSTEMS DESIGN II (3-0).
The human element in man-machine systems. Selected topics in human engineering and psychophysics with emphasis on their relation to military systems. Man-machine interface and man's motor and sensory capacities. PREREQUISITE: A course in statistics.

OA3501 INVENTORY I (4-0).
A study of deterministic and approximate stochastic inventory models. Deterministic economic lot size models with infinite production rate, constraints, quantity discounts. An approximate lot size-reorder point model with stochastic demand. An approximate stochastic periodic review model. Single period stochastic models. Applications to Navy supply systems. PREREQUISITE: OA3101 or consent of instructor.

OA3601 COMBAT MODELS AND GAMES (4-0).
This course provides a discussion of measures of effectiveness and a quantitative introduction to dynamic programming, target coverage models, Kalman filters, Lanchester Systems and two-person, zero-sum games. PREREQUISITES: MA3110, OA3102.

OA3602 SEARCH THEORY AND DETECTION (4-0).
Search and detection as stochastic processes. Characterization of detection devices, use and interpretation of sweep widths and lateral range curves, true range curves. Measures of effectiveness of search-detection systems. Allocation of search efforts, sequential search. Introduction to the statistical theory of signal detection. Models of surveillance fields, barriers, tracking and trailing. PREREQUISITE: OA3301.

OA3610 INTRODUCTION TO NAVAL LOGISTICS (4-0).
This course is designed to teach students the fundamental purposes, history and components of the naval logistics system. Logistics is introduced as a command function necessary for sustaining combat operations. Specific topics include logistics resources and processes, unit logistics, battle group logistics, in-theater support, strategic lift, the functions of the CONUS shore establishment and DOD acquisition in support of existing forces. At each level, existing programs and policies are discussed and evaluated in the context of the ability to support combat operations. PREREQUISITES: None.

OA3900 WORKSHOP IN OPERATIONS RESEARCH/SYSTEMS ANALYSIS (V-0).
This course may be repeated for credit if course content changes. PREREQUISITE: Departmental approval. Graded on Pass/Fail basis only.

OA3910 SELECTED TOPICS IN OPERATIONS RESEARCH/ SYSTEMS ANALYSIS (Variable hours 2-0 to 5-0) (V-0).
Presentation of a wide selection of topics from the current literature. This course may be repeated for credit if course content changes. PREREQUISITE: A background of advanced work in operations research. Consent of instructor.

OA4101 DESIGN OF EXPERIMENTS (3-1).
Theory and application of the general linear hypothesis model. Analysis of variance and analysis of covariance. Planning experiments, traditional and hybrid experimental designs. Use of standard computer packages for analysis of experimental data. PREREQUISITE: OA3103 or equivalent.

OA4102 REGRESSION ANALYSIS (4-0).
Construction, analysis and testing of regression models. An in-depth study of regression and its application in operations research, economics and the social sciences. PREREQUISITES: OA3102, OA3103 and OA3104.

OA4103 ADVANCED PROBABILITY (3-0).
Probability spaces, random variables as measurable functions, expectation using the Lebesque Stieltjes integral and abstract integration. Modes of convergence, characteristic functions, the continuity theorem, central limit theorems, the zero-one law. Conditional expectation. PREREQUISITE: MA3605 or departmental approval.

OA4104 ADVANCED STATISTICS (3-0).
Foundations of statistics from a decision-theoretic viewpoint. Robust estimation techniques, biased estimation. Fisher and Kullback information, asymptotic methods. Sufficiency, completeness, the Cramer-Rao inequality. Sequential tests, empirical Bayes tests. Statistical computation methods. PREREQUISITES: OA3103 and consent of instructor.

OA4201 NONLINEAR PROGRAMMING (4-0).
Introduction to modern optimization techniques, Karesh-Kuhn-Tucker necessary and sufficient conditions for optimality, quadratic and separable programming, basic gradient search algorithms and penalty function methods. Applications to weapons assignment, force structuring, parameter estimation for nonlinear or constrained regression, personnel assignment and resource allocation. PREREQUISITES: OA3201 and MA3110.

OA4202 NETWORK FLOWS AND GRAPHS (4-0).
Introduction to formulation and solution of problems involving networks. Elements of graph theory, data structures, search algorithms, max-flow mincut theorem, shortest route problems, minimum cost flows and PERT/CPM. Applications to production and inventory, routing, scheduling, network interdiction and personnel management. PREREQUISITE: OA3201.

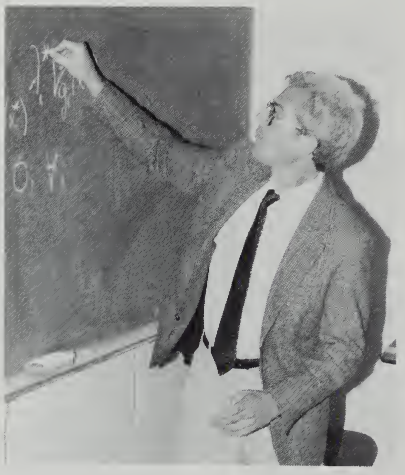
OA4203 MATHEMATICAL PROGRAMMING (4-0).
Advanced topics in linear programming, large scale systems, the decomposition principle, additional algorithms, bounded variable techniques, linear fractional programming, formulation and solution procedures for problems in integer variables. Applications to capital budgeting, large scale distribution systems, weapon systems allocation and others. PREREQUISITE: OA3201.

OA4204 GAMES OF STRATEGY (4-0).
Mathematical models of conflict situations, emphasizing the theory of decision making against a completely opposed enemy. Topics include matrix games, Blotto games, stochastic games and the Shapley value. Applications to combat, resource allocation, cost sharing, etc. PREREQUISITES: OA3201 and OA3101 or consent of instructor.

OA4205 ADVANCED NONLINEAR PROGRAMMING (4-0).
Continuation of OA4201. Advanced topics in non-linear programming including duality theory, further consideration of necessary and sufficient conditions for optimality, additional computational methods examination of recent literature in non-linear programming. PREREQUISITE: OA4201.

OA4206 DYNAMIC PROGRAMMING AND OPTIMAL CONTROL (4-0).
The basic theory, including Bellman's equation and the Maximum Principle. Applications to tactical and economic problems. PREREQUISITE: OA3201.

OA4301 STOCHASTIC MODELS II (3-2).
Course objectives are to teach methods of stochastic modeling beyond those taught in OA3301 and to give students an opportunity to apply these tools to real world problems. Suitably selected projects that entail data collection and analysis are undertaken, with emphasis on problem formulation, choice of appropriate assumptions and attainment of practical results. Topics include renewal processes and further topics in queuing, illustrated by several military and industrial applications. PREREQUISITES: OA3301, OA3302 and OA3104.



OA4302 RELIABILITY AND WEAPONS SYSTEM EFFECTIVENESS MEASUREMENT (4-0).
Component and system reliability functions and other reliability descriptors of system effectiveness. Relationships between system and component reliability. Point and interval estimates of reliability parameters under various life testing plans. PREREQUISITE: OA3301.

OA4303 SAMPLE INSPECTION AND QUALITY ASSURANCE (4-0).
Attribute and variables sampling plans. MILSTD sampling plans with modifications. Multi-level continuous sampling plans and sequential sampling plans. Structure and implementation of quality assurance programs and analysis of selected quality assurance problems. PREREQUISITE: OA3101 or consent of instructor.

OA4304 DECISION THEORY (3-0).
Basic concepts, Bayes, admissible, minimax and regret strategies. Principles of choice. Relation of statistical decision functions to the theory of games. Application in the planning of operational evaluation trials. PREREQUISITE: OA3103.

OA4305 STOCHASTIC MODELS III (4-0).
Lecture topics include, non-stationary behavior of Markov processes, point process models, regenerative processes, Markovian queuing network models and non-Markovian systems. Applications to include reliability, computer system modeling, combat modeling and manpower systems. Students are given exercises entailing data analysis, formulation of probability models and application of models to answer specific questions concerning particular phenomenon. PREREQUISITES: OA3104, OA3301 and OA4301.

OA4306 STOCHASTIC PROCESSES I (4-0).
A selection of topics from the Kolmogorov theorem, analytic properties of sample functions, continuity and differentiability in quadratic mean, stochastic integrals, stationary processes, non-stationary processes, martingale limit theorems, the invariance principle, Markov and Gaussian processes. PREREQUISITE: OA4103.

OA4307 STOCHASTIC PROCESSES II (4-0).
A continuation of OA4306. PREREQUISITE: OA4306.

OA4308 TIME SERIES ANALYSIS (4-0).
Second order stationary processes. Harmonic analysis of correlation functions. Filters and spectral windows. Ergodic properties. Problems of inference in time series analysis. Box-Jenkins techniques. Introduction to the analysis of multivariate processes. PREREQUISITES: OA3301 and OA3104.

OA4321 DECISION SUPPORT SYSTEMS (3-1).
An introduction to the topic; includes an overview of organizational decision making, discussion of OR techniques integral to DDS, relationships to artificial intelligence and expert systems, specialized computer languages and non-traditional techniques for handling uncertainty. Current operational systems, both military and civilian, will be used as examples. PREREQUISITES: OA3200 and OA3101 or consent of instructor.

OA4333 SIMULATION METHODOLOGY (4-0).
Advanced techniques of model development and simulation experimentation. Discussion of current research. Actual topics selected will depend on interests of students and instructor. PREREQUISITE: OA3302.

OA4401 HUMAN PERFORMANCE EVALUATION (4-0).
Experimental considerations, strategy and techniques in evaluation of human performance characteristics and capabilities. Detailed examination of special methods to include multivariate designs, psychophysiological methods. Review of important variables affecting human performance and criteria, measures of effectiveness and figures of merit as indicants of performance quality. PREREQUISITE: OA3401.

OA4402 SKILLED OPERATOR PERFORMANCE (3-2).
First part of the course is devoted to an examination of the theoretical foundations of skilled performance. The second half of the course is devoted to the study of the acquisition, development and prediction of skilled operator performance in the operational setting. PREREQUISITE: OA3401.

OA4404 OPERATIONS RESEARCH IN MAN-MACHINE SYSTEMS (4-0).
Application of operations research techniques to man-machine design and evaluation problems. Quantitative methods for performance will be treated using such concepts as reliability, information theory and signal detection theory. A portion of the course is devoted to summarizing approaches to real world problems incorporating current methods from the literature. PREREQUISITES: OA3401, OA3201, OA3301 and OA4301 (may be taken concurrently).

OA4501 SEMINAR IN SUPPLY SYSTEMS (4-0).
A survey of the supply system for the U.S. Navy. Topics include the inventory models at all levels for consumables and repairables, budget formulation and execution, provisioning and allowance lists, planned program requirements, transaction item reporting and current topics of research such as stock migration and material distribution studies. PREREQUISITE: OA3501.

OA4502 INVENTORY II (4-0).
A study of stochastic inventory models. Single period models with time dependent costs, constrained multiple item single period models, deterministic and stochastic dynamic inventory models, the periodic review model, the Q-1 continuous review model. PREREQUISITES: OA3301 and OA3501.

OA4602 CAMPAIGN ANALYSIS (4-0).
The development, use and state-of-the-art of maritime campaign analysis. Emphasis is on formulating the analysis, measures of effectiveness, handling assumptions and parametric evaluations. Communicating results in speech and writing is an important part of the course. Students conduct a project as study team members. They research and report on major portions of major U.S. Navy analyses. PREREQUISITES: OA3103, OA3302, OA3601, OA3602, OA4604 and SECRET NOFORN clearance.

OA4603 TEST AND EVALUATION (3-2).
This course relates the theory and techniques of operations research to the problems associated with test and evaluation. Specific examples of exercise design, reconstruction and analysis are examined. PREREQUISITE: OA3104.

OA4604 WAR GAMING ANALYSIS (4-0).
Analysis of problems in the design, construction and application of manual, computer and interactive gaming. Emphasis is on gaming as a means of evaluating Naval Warfare tactics. NWISS and NAVTAG gaming facilities will be used. PREREQUISITES: OA3302 and SECRET NOFORN clearance.

OA4605 OPERATIONS RESEARCH PROBLEMS IN NAVAL WARFARE (3-0).
Analysis of fleet exercises. Changes in tactics and force disposition arising from the introduction of nuclear weapons and missiles. Relationship of air defense to strike capability and ASW. Current radar, sonar, communications and ECM problems. PREREQUISITES: OA3601 and OA4604.

OA4606 APPLICATIONS OF SEARCH, DETECTION AND LOCALIZATION MODELS TO ASW (3-0).
Applications of search, detection and localization models to search planning, target localization and tracking procedures and ASW sensor evaluation. Both acoustic and non-acoustic ASW sensors are considered. PREREQUISITES: OS3601 or OA4604 and SECRET NOFORN clearance.

OA4607 TACTICAL DECISION AIDS (3-2).
An in depth review of modern Naval Tactical Decision Aids, particularly those involving computers. JOTS, ITDA, TESS and a variety of search planning aids. Principles of organization, computation, display and testing. Project required. PREREQUISITES: OA3602, OS3601, or consent of instructor.

A4608 SOVIET MILITARY OPERATIONS RESEARCH (4-0).

his course provides an introduction to Soviet military operations esearch, with an emphasis on asymmetries in Soviet and American use f military OR. It will focus on how OR influences oviet military theory and practice. It will begin by xamining the Soviet military mind as influenced y the Russian/Soviet historical experience, arxist-Leninist ideology and Soviet social and ilitary institutions. It will then trace the istorical development of military OR in the Soviet nion and discuss its nature today. Students will eceive English translations of major Soviet works n military OR. PREREQUISITES: Course on ombat modeling (e.g. OA3601 or OA4654) or onsent of instructor and SECRET NOFORN learance.

A4610 MOBILIZATION (4-0).

ntroduction to the military and civilian systems r mobilization, linear programming and imulation formulations of strategic mobility and unitions scheduling. Planning and controls of the gistics systems, including planning factors and int operations planning. Integration of obilization with Navy operational logistics.

A4611 LOGISTICS IN NAVAL WARFARE (4-0).

his course is designed to teach students the role of logistics and gisticians in war planning and strategy development. Students are troduced to the Joint Chiefs of Staff, the world wide military command ystem and the Joint Strategic Planning System (JSPS). They will work hrough development of plans using deliberate planning, Time-Phased orce Deployment Data (TPFDD) and logistic planning factors. Student ill be introduced to the Maritime Strategy and Navy planning based on WP-11. The Weapon system acquisition process is examined as it elates to planning. The transition to war and mobilization are discussed nd the problems with current organizations are analyzed in this regard. ogistics in the Soviet Navy are examined. PREREQUISITES: OA3610 nd MN4373 and SECRET clearance/NOFORN.

A4612 LOGISTICS MODELS (4-0).

athematical modeling of most of the processes in unit/battle group or attle force logistics. Computation of fuel consumption, underway eplenishment scheduling, shuttle ship requirements, measures of ffectiveness, formations and their supportability, sustainability, ngagement models and ordnance prediction and implementation of such odels in microprocessor-based logistics decision aids. Also ordinance rogramming models. Only for US students enrolled in curricula 360 or 61. PREREQUISITE: Consent of instructor.

A4654 AIRLAND COMBAT MODELS I (4-0).

ntroduction to modeling air/ground combat operations with emphasis on etailed approaches for modeling small-scale combat. Topics include: ypes of models, the modeling process, verification, target acquisition odels, target selection, weapon accuracy, lethality models, terrain ffects, tactical decision making and integration of these models into rge scale simulation models of combat. Models currently in use in DOD nalysis are used as examples throughout the course. PREREQUISITE: A3301.

OA4655 AIRLAND COMBAT MODELS II (4-0).
Modeling of large scale air/ground combat operations using aggregated force on force combat models. Topics include: Aggregation and disaggregation, types of models used for large scale operations, firepower index and Lanchester equation approaches to attrition modeling, movement rate of advance models, air warfare models and air allocation, logistics, C3 I process models, artificial intelligence applications. Models currently in use for DOD analysis are used as examples throughout the course. PREREQUISITE: OA3301 or consent of the instructor.

OA4701 ECONOMETRICS (4-0).
Construction and testing of econometric models, analysis of economic time series and the use of multivariate statistical analysis in the study of economic behavior. PREREQUISITE: OA3103.

OA4702 COST ESTIMATION (4-0).
Advanced study in the methods and practice of systems analysis with emphasis on cost analysis; cost models and methods for total program structures and single projects; relationship of effectiveness models and measures to cost analysis; public capital budgeting of interrelated projects; detailed examples from current federal practices. PREREQUISITE: AS3611 or equivalent.

OA4703 DEFENSE EXPENDITURE AND POLICY ANALYSIS (4-0).
A presentation of the major components of defense budgeting and policy formulation from the standpoint of the three major institutions involved, the agency, the executive branch and congress. The use of quantitative models of institutional behavior is emphasized when examining both individual institutions and the interaction between them. PREREQUISITE: AS3611.

OA4704 O/R TECHNIQUES IN MANPOWER MODELING (4-0).
The most frequently applied manpower models are studied including Markov chain and renewal models using grade and/or length of service categories. Statistical techniques to estimate relevant attrition and promotion rates from cohort and census data are also included in the course to provide both longitudinal and cross-sectional views of personnel systems. Career aspects are analyzed with respect to attrition, promotion opportunity and time to promotion in hierarchical systems with or without promotion zones. Examples emphasize the personnel systems of the military services. PREREQUISITES: OA3201, OA3301 and OA3103.

OA4910 SELECTED TOPICS IN OPERATIONS ANALYSIS (Variable hours 2-0 to 5-0) (V-0).
Presentation of a wide selection of topics from the current literature. This course may be repeated for credit if course content changes. PREREQUISITES: A background of advanced work in operations research and departmental approval.

OA4930 READINGS IN OPERATIONS ANALYSIS (Variable hours 2-0 to 5-0) (V-0).
This course may be repeated for credit if course content changes. PREREQUISITE: Departmental approval. Graded on Pass/Fail basis only.

OS0810 THESIS RESEARCH FOR C3 STUDENTS (0-0).
Every student conducting thesis research will enroll in this course.

OS2101 ANALYSIS OF EXPERIMENTAL DATA (4-0).
Introduction to statistical analysis of measurements and experimental data. Frequency distributions, graphical representation. Populations and sampling. Principle of least squares, estimation of mean and standard deviation. Curve fitting and regression, propagation of errors. Confidence intervals, tests and contingency tables. Elementary ANOVA. Relevant probabilistic concepts introduced as needed.

OS2102 INTRODUCTION TO APPLIED PROBABILITY FOR ELECTRICAL ENGINEERING (4-1).
First course in probability. Structure of a probability model, density, distribution functions, expectation and variance. Some basic models, binomial, Poisson and Gaussian distributions. Conditional probability and independence. Joint distributions, covariance and central limit theorem. Transformations of random variables. PREREQUISITE: MA1118 or equivalent.

OS2103 APPLIED PROBABILITY FOR SYSTEMS TECHNOLOGY (4-1).
First course in probability for students in operational curricula. Topics include classical probability calculation, discrete and continuous random variables, basic probability distributions, introduction to modeling, expectation, variance, covariance and rudiments of discrete-time processes. Emphasis is on developing familiarity with basic concepts and computational skills rather than mathematical rigor. Problem session is used in part to refresh and reinforce necessary calculus topics. PREREQUISITE: MA1118.

OS2210 INTRODUCTION TO COMPUTER PROGRAMMING (4-1).
An introduction to the operation and programming of the mainframe computer and portable programmable computers used in the ASW Curriculum. The FORTRAN and BASIC languages are emphasized.

OS3001 OPERATIONS RESEARCH FOR COMPUTER SCIENTISTS (4-0).
An introduction to some methodology and techniques of operations research that are relevant to computer system performance modeling and specification. Topics include Poisson processes, reliability theory and queuing theory.

OS3002 OPERATIONS RESEARCH FOR NAVAL INTELLIGENCE (4-0).
This course provides an introduction to the approach and methods of operations research, with special emphasis on military applications of interest to intelligence. It focuses on the mathematical modeling of combat operations and considers intelligence aspects (particularly Soviet use of OR). Students develop basic skills in such modeling. Topics include: operational definitions, measurement of combat effectiveness, model validation/verification and models versus modeling. Also included are modeling of processes of target acquisition, fire assessment (kill probabilities and target coverage), tactical decision making and games.

OS3003 OPERATIONS RESEARCH FOR ELECTRONIC WARFARE (4-0).
This course deals with applications of quantitative models to operational electronic warfare problems, with the underlying idea being to make decisions by optimizing some measure of effectiveness (MOE). Topics covered include ESM, ECM/ECCM, strike warfare. ASMD and cost-effectiveness tradeoffs. PREREQUISITES: Calculus and OS2103.

OS3004 OPERATIONS RESEARCH FOR COMPUTER SYSTEMS MANAGERS (5-0).
A one-quarter survey of operations research techniques of particular interest to students in computer systems management. Model formulation, decision theory, linear programming, project management techniques, inventory models, queuing and simulation, reliability and maintainability. Examples will illustrate the application of these techniques to the management of computer systems. PREREQUISITES: MA2300 and OS3101.

OS3005 OPERATIONS RESEARCH FOR COMMUNICATIONS MANAGERS (4-0).
A one-quarter survey of operations research techniques of particular interest to students in communications management. Model formulation, decision theory, games, linear programming, network flows, CPM and PERT, reliability and maintainability, Queuing theory and systems simulation. PREREQUISITES: MA2300, OS3101 or OS3105.

OS3006 OPERATIONS RESEARCH FOR MANAGEMENT (4-0).
A survey of problem solving techniques for operations research. Topics include decision theory, linear programming, models, project scheduling, inventory, queuing and simulation. PREREQUISITES: MA2300, OS3101 or OS3105.

OS3007 OPERATIONS RESEARCH METHODOLOGY (4-0).
Survey of operations research techniques not covered in OS3006. Topics may include simulation, search theory, extensions of combat models, network flows and Markov chains. PREREQUISITES: OS3106 and OS3006 concurrently.

OS3008 ANALYTICAL PLANNING METHODOLOGY (4-0).
A one-quarter survey of operations research techniques of particular interest to students in the C3 curriculum, with emphasis on model formation. Topics include linear and nonlinear programming, integer programming, networks, shop flow and project scheduling, decision analysis, queuing and simulation. PREREQUISITE: MA2300.

OS3101 STATISTICAL ANALYSIS FOR MANAGEMENT (4-1).
A specialized course covering the basic methods of probability and statistics with emphasis on managerial applications. The course includes applications of probability models, statistical inference and regression analysis. Computation for these applications are carried out on a computer, using commercial software packages. Topics in probability include the binomial, geometric, Poisson and normal distributions, risk and expected value. Parametric statistical techniques include significance testing and confidence intervals, together with point estimation of model parameters. Regression analysis includes simple linear regression and multiple regression, with estimation of parameters and tests of hypothesis and confidence intervals for regression coefficients and the variance of the error term. PREREQUISITE: College algebra.

OS3104 STATISTICS FOR SCIENCE AND ENGINEERING (4-0). Acquaint the engineering student with the techniques of statistical data analysis with examples from quality control, life testing, reliability and sampling inspection. Histograms, empirical distributions and random variables are introduced along with their probability distributions and associated characteristics such as moments and percentiles. Following a brief introduction to decision making, standard tests of hypotheses and confidence intervals for both one and two parameter situations are treated. Regression analysis is related to least squares estimation and associated tests of hypotheses and confidence intervals are treated. PREREQUISITE: Calculus.

OS3105 STATISTICAL ANALYSIS FOR MANAGEMENT I (4-1). The first of a two-quarter course in the use of the tools of probability and statistics oriented toward management applications. Skills in numerical computation are developed in laboratory periods through the use of MINITAB. Emphasis in the lectures is placed on modeling problems and interpreting results. Those aspects of probability structure that are germane to distributions such as the binomial and normal. Standard topics of statistical inference for one and two variables are introduced in the settings of both hypothesis testing and confidence interval estimation. PREREQUISITE: MA2300.

OS3106 STATISTICAL ANALYSIS FOR MANAGEMENT II (4-1). The second of a two-quarter course in the use of the tools of probability and statistics oriented toward management applications. Using the tools and skills developed in OS3105, the course consists of a general study of linear models. Analysis of variance for one and two way models is followed by simple linear and multiple regression including such topics as curve fitting, residual analysis and stepwise regression, along with correlation analysis. Again the computer is used as a tool to facilitate computations with emphasis on statistical packages for large data bases, such as SPSS and SAS. The course concludes with a sampling of nonparametric procedures. PREREQUISITE: OS3105.

OS3301 SYSTEMS EFFECTIVENESS CONCEPTS AND METHODS (4-0). An introduction to system reliability, maintainability and effectiveness analysis. Failure (repair) rates and mean times to failure (repair). Models for aging and completion. Block diagrams and fault trees. Life testing, availability, interval reliability and the synthesis of reliability, maintainability and effectiveness analysis. PREREQUISITES: OS3105 and OS3106.

OS3303 COMPUTER SIMULATION (4-1). Design, implementation and use of digital simulation models will be covered with special emphasis on features common to ASW problems. War gaming will be discussed and a game using the digital computer will be played and critiqued by the class. Exercise planning and analysis will be treated. Basic topics are explained including computer generation of random variates, statistical design and monitoring of model progress, machine representation of dynamic data structures, model verification, and validation on special purpose simulation and gaming languages. PREREQUISITES: OS2103, OS3604 or equivalent and a working knowledge of FORTRAN programming.

OS3401 HUMAN FACTORS ENGINEERING (3-0).
An introduction to human factors engineering for students in fields such as engineering. Designed to give the student an appreciation of man's capacities and limitations and how these can affect the optimum design of the man-machines system. Emphasis on integration of human factors into the system development cycle considering such topics as manpower/personnel costs, control and display design, human energy expenditure, physiological costs and evaluation systems. PREREQUISITE: A previous course in probability and statistics.

OS3402 HUMAN FACTORS FOR ANTISUBMARINE WARFARE (3-1).
Course involves an examination of man's attentiveness and capability in the detection of changes in stimulus events over prolonged periods of observation. Topics to be covered include theories of vigilance; task, signal, subject and environmental influences on performance, physiological and psychological responses and vigilance performance measurement. This course is designed for the ASW curriculum. PREREQUISITE: None.

Richard E. Rosenthal
Professor, Operations Research

For Rick Rosenthal, who has been at the Naval Postgraduate School since 1984, it's the quality of the people at NPS that he finds most attractive. "What I like best about NPS is the whole research environment that comes from having outstanding colleagues and professional caliber students," he says.

"I was attracted to the school first and foremost by my colleagues, some of whom are among the best in the world at what they do. But, coming from a civilian university, I hadn't anticipated how fantastic the students would be. They're bright, hardworking, independent thinkers. As professionals, they have a great deal of experience to share. And I feel I can apply my expertise to their profession. It's a perfect combination."

Rosenthal's research specialty is in optimization, using mathematical models and computer algorithms to find the most effective use of scarce resources. Specifically, his current project is the Space Targeting Optimization Modeling Program, involving the allocation of antisatellite devices. "I have a lot of background in the theory of optimization and a passion for applying it to real-world problems," says Rosenthal of his work. "It has been fun working on this application with my students. Our research sponsor, the Naval Space Command and the United States Space Command, have been very pleased with the results. My students and I are the first to apply optimization to this space problem; other people have analyzed it in a descriptive fashion, but have not tried to mathematically determine the best solutions."

Rosenthal rates the Operations Research Department at NPS among the top ten in the country. "For the master's degree we're probably #1," he says. "We offer as good a Masters of Science in Operations Research as you can get."

OS3403 HUMAN FACTORS IN ELECTRONIC WARFARE (3-1).
This course will provide the student with the ability to evaluate and predict human performance in specified operational environments. The effects of stress factors such as noise, temperature, motion, work load, etc., on various aspects of human performance will be studied. Students will identify the control and display requirements for an EW system and design a workspace to accommodate an EW data reduction/analysis system. PREREQUISITE: OS3604.

OS3404 MAN-MACHINE INTERACTION (3-2).
An introduction to the man-machine interface problems in C3. Information, display and human communication requirements for effective C3. Applied orientation with student receiving his own computerized mailbox on the ARPANET enabling him to experience message handling systems, query languages, computer to computer communications between the U.S. and Europe, command and control applications programs, file transfer between host computers, etc. PREREQUISITE: Enrollment in C3.

OS3601 SEARCH, DETECTION and LOCALIZATION MODELS (4-0).
An introduction to the decision problems associated with Navy detection systems. The relation of detection models to search and localization models, measures of effectiveness of search/detection systems and the optimum allocation of search effort are discussed. This course is designed for the ASW curriculum. PREREQUISITES: OS2103, PH2401 or consent of instructor and SECRET clearance.

OS3602 ASW COMBAT ANALYSIS (4-0).
This course deals with the analysis of ASW operations. Topics include the analysis of force integration and communications, combat attrition, system reliability, target tracking, target data fusion and system measures of effectiveness. The course is designed for the ASW curriculum PREREQUISITES: OS2103 and OS3601 or consent of instructor.

OS3603 SIMULATION AND WAR GAMING (3-1).
Design, implementation and use of digital simulation models will be covered with special emphasis on features common to C3 and EW problems. War gaming will be discussed and a game using the digital computer will be played and critiqued by the class. Exercise planning and analysis will be treated. Basic topics are explained including computer generation of random variates, statistical design and monitoring of model progress, machine representation of dynamic data structures, model verification and validation on special purpose simulation and gaming languages. PREREQUISITES: OS2103, OS3604 or equivalent and a working knowledge of FORTRAN programming and SECRET clearance.

OS3604 DECISION AND DATA ANALYSIS (4-0).
This course provides an introduction to the techniques of decision analysis, statistics and data analysis. It is primarily for students in the ASW, EW and C3 curricula. Emphasis is placed on the analysis of data and decision making in the ASW, EW and C3 environments. PREREQUISITE: OS2103 or equivalent.

OS3636 ARCHITECTURE OF C3I SYSTEMS (4-0).
This course is primarily intended for students in the command and control program. It provides on introduction to the evaluation and modeling of Command, Control, Communications and Intelligence (C3I) systems, with an emphasis on the comparative anatomy of Blue and Red systems and Operational Intelligence. The student is introduced to concepts pertaining to the design, functioning and evaluation of such large-scale systems and their architecture. PREREQUISITES: U.S. citizenship and TOP SECRET clearance with eligibility for SBI.

OS3637 SOVIET OPERATIONS AND SYSTEMS (4-0).
This course is intended for students in any of the operational curricula (but primarily the C3 program). It provides an introduction to Soviet thinking, conceptualization of military affairs, systems and operations. Soviet control concepts, including troop control, control of combat means and the role of automation, are emphasized. The systems approach to integrating different types of intelligence data to support U.S. defense (including command) decision making is considered. The course stresses the understanding of Soviet key words and concepts in military affairs. PREREQUISITES: U.S. citizenship and TOP SECRET clearance with eligibility for SI/SAO.

OS3702 MANPOWER REQUIREMENTS DETERMINATION (4-0).
The objective is to enable the student to use some of the tools of industrial engineering in the determination of the quantity and quality of manpower required in military systems. Techniques include motion and time study, work sampling, predetermined time standards, work design and layout, materials handling, procedures review and process design. Applications for ship and squadron manning documents and SHORESTAMPS are included. PREREQUISITES: OS3006, or OA3201 and OA3301.

OS4601 TEST AND EVALUATION (4-0).
Designed for system technology students, this course examines problems associated with tests and evaluations of weapon systems and tactics. Included are concepts from experimental design, regression analysis. Realistic data sets and examples are discussed and analyzed. PREREQUISITE: Inferential statistics.

OS4602 C3 SYSTEMS EVALUATION (2-4).
This course is designed for Systems Technology students in the Command, Control and Communications Curriculum. The course deals with techniques for the design, implementation and analysis of experiments or exercises aimed at the test and evaluation of systems, tactics or operational concepts. Course topics include modeling, experimentation methodology, design of experiments, multi-criteria decision analysis, reliability and man-machine interaction. Case studies and real data will be examined and students will actively participate in evaluations through laboratory experiments. PREREQUISITES: OS3008, OS3603, OS3604 and SECRET NORFORN clearance.

OS4701 MANPOWER AND PERSONNEL MODELS (4-0).
The objective of this course is to introduce the student to the major types of manpower and personnel models for estimating the effects of policy changes on the personnel system. Topics include longitudinal and cross-section models, optimization models, data requirements and validation. Applications in the form of current military models are included. PREREQUISITES: OS3006 and OS3106.

DEPARTMENT OF PHYSICS

Robert Louis Armstead, Associate Professor (1964)*; PhD, University of California at Berkeley, 1964.

Anthony A. Atchley, Associate Professor (1985); PhD, University of Mississippi, 1985.

Steven Richard Baker, Assistant Professor (1985); PhD, University of California at Los Angeles, 1985.

Fred Ramon Buskirk, Professor, (1960); PhD, Case Institute of Technology, 1958.

David Dempster Cleary, Assistant Professor (1988); PhD, Colorado, 1985.

William Boniface Colson, Professor (1989); PhD, Stanford University, 1977.

Alfred William Madison Cooper, Professor (1957); PhD, The Queen's University of Belfast, 1961.

Alan Berchard Coppens, Associate Professor (1964); PhD, Cornell University, 1965.

Harvey Arnold Dahl, Assistant Professor (1964); PhD, Stanford University, 1963.

David Scott Davis, Associate Professor (1989); PhD, Purdue University, 1976.

Steven Lurie Garrett, Professor (1982); PhD, University of California at Los Angeles, 1977.

Suntharalingam Gnanalingam, Adjunct Professor (1985); PhD, Cambridge University, 1954.

Otto Heinz, Professor (1962); PhD, University of California at Berkeley, 1954.

Dan Howard Holland, Adjunct Professor (1990); PhD, Stanford University, 1955.

Xavier K. Maruyama, Professor (1987); PhD, Massachusetts Institute of Technology, 1971.

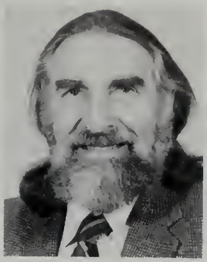
Edmund Alexander Milne, Associate Professor (1954); PhD, California Institute of Technology, 1954.

John Robert Neighbours, Professor (1959); PhD, Case Institute of Technology, 1953.

Richard Christopher Olsen, Associate Professor (1987); PhD, University of California at San Diego, 1980.

James Vincent Sanders, Associate Professor (1961); PhD, Cornell University, 1961.

Gordon Everett Schacher, Dean of Faculty and Graduate Studies, Professor (1964); PhD, Rutgers, 1961.



Chairman:
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Associate Chairmen:

Administration
William B. Zeleny,
Associate Professor,
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AV 878-2952.

Instruction
Robert L. Armstead,
Associate Professor,
Code PH/Ar, Spanagel Hall,
Room 112,
(408) 646-2125,
AV 878-2125.

Fred Richard Schwirzke, Professor (1967); PhD, University of Karlsruhe, 1959.

Donald Lee Walters, Associate Professor (1983); PhD, Kansas State University, 1971.

Oscar Bryan Wilson, Jr., Professor (1957); PhD, University of California at Los Angeles, 1951.

Karlheinz Edgar Woehler, Chairman and Professor (1962); PhD, University of Munich, 1962.

William Bardwell Zeleny, Associate Professor (1962); PhD, Syracuse University, 1960.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

Expertise in the Department of Physics and efforts in research and teaching of graduate specialization courses for the last twenty years can be summarized under the heading “physics of propagation phenomena in realistic, complex environments”. Specialized course sequences are offered in the following areas:

1) Optical Signal Propagation and Detection.
2) Directed Energy Weapons Systems.
3) Nuclear Weapons and their Effects.
4) Underwater Acoustics.
5) Physics of the Space and Satellite Environment.
6) Physics of Solids and Solid State Devices.
7) Simulation of Large Scale Systems.
8) Classical Field Theory.

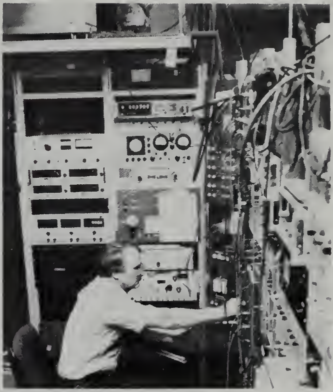
All of these specializations, except the last, are of obvious relevance to modern and future weapons technologies. The faculty supports an ongoing research program in these areas and student thesis topics are available in all of them.

DEGREE REQUIREMENTS

The Department of Physics offers the Master of Science degree in Physics and in Engineering Science. In addition, the Ph.D. is offered by the department. Upon approval by the department, courses taken at other institutions may be applied towards satisfying degree requirements.

MASTER OF SCIENCE IN PHYSICS

A candidate for the degree Master of Science in Physics must complete satisfactorily a program of study which includes a minimum of 30-quarter hours of physics courses (not including thesis) distributed among courses at the graduate (3000 or 4000) level; of these 30 hours at least 15 hours must be at the 4000 level. Upon approval of the Chairman of the Physics Department, a maximum of 4 hours of courses taken in another department may be applied toward satisfying the above requirements. In lieu of the preceding requirements, students who are qualified to pursue graduate courses in physics when they arrive at the Naval Postgraduate School may complete a minimum of 20 hours entirely of 4000-level physics courses. In addition, all students must satisfy the general Postgraduate School minimum requirements for the master's degree and present an acceptable thesis.



The following specific course requirements must be successfully completed for a student to earn the degree Master of Science in Physics:

1) PH3152: Mechanics II - Extended Systems,
   PH3352: Electromagnetic Waves,
   PH3683: Intermediate Quantum Physics,
   PH3990: Methods of Theoretical Physics,
   PH3782: Thermodynamics and Statistical Physics, or equivalents to the above courses.

2) Either PH4353: Topics in Advanced Electricity and Magnetism or PH4984: Advanced Quantum Physics

3) In addition to the above, a graduate sequence containing at least two Physics courses, at least one of which must be at the 4000 level.

All programs leading to the degree Master of Science in Physics must be approved by the Chairman of the Department of Physics.

MASTER OF SCIENCE IN ENGINEERING SCIENCE

Students of the Weapon Systems Engineering Curriculum (530) who elect a Physics area as their specialization option will receive the degree Master of Science in Engineering Science. The program must include at least 36-credit hours of graduate work in engineering, science and mathematics, at least 12 of which must be at the 4000 level. Of these 36 hours, at least 20 hours, including work at the 4000 level, must be in the Department of Physics. This will be the major department and cognizance over the specialization course sequences, thesis research areas and the degree resides with the Chairman of the Department of Physics.

In addition to the major, the program must contain at least 12 hours at the graduate level in courses representing areas other than the major.

The candidate must present an acceptable thesis on a topic given prior approval by the Department of Physics. Final approval of the program leading to the Master of Science in Engineering Science with major in Physics shall be obtained from the Chairman of the Department of Physics.

DOCTOR OF PHILOSOPHY

The Ph.D. degree is offered in the department in several areas of specialization which currently include acoustics, atomic physics, solid state physics, theoretical physics, nuclear physics and plasma physics.

Requirements for the degree may be grouped into three categories: courses, thesis research and examinations in major and minor fields.

The required examinations are outlined under the general school requirements for the doctor's degree. In addition to the school requirements, the department requires a preliminary examination to show evidence of acceptability as a doctoral student.

The usual courses to be taken by the candidate include Classical Electrodynamics, Quantum Mechanics and Statistical Physics (PH4371, PH4971, PH4972, PH4973, PH4771, PH4772). Suitable electives are to be chosen in physics and the minor fields, mainly from the list of graduate-level courses.

PHYSICS LABORATORIES

The physics laboratories are equipped to carry on instruction and research work in atomic physics, nuclear physics, solid state physics, electro-optics, plasma physics, spectroscopy and acoustics.

The 100 MeV electron linear accelerator provides a pulsed electron beam of 1 microampere average current and is used for radiation studies. This machine is being augmented by a Pulserad 112 single pulse electron accelerator producing a 1.8 MeV, 40 kiloampere beam of 50 nanosecond duration. Both machines are suitable for studies of radiation effects in semiconductor devices and electromagnetic pulse generation.

The Electro-Optics Laboratory uses imaging and detecting systems from the far infrared to the visible range including instrumentation for seagoing experiments in optical propagation. The Laser Laboratory contains a giant pulse laser and associated detection equipment for the visible spectrum as well as a high power laser in the IR region.

The spectroscopy equipment includes two infrared spectrophotometers and a near IR-visible-UV spectrophotometer. The spectroscopic data center contains a comprehensive compilation of the known energy levels and atomic spectral lines in the vacuum ultraviolet range.

The Acoustics Laboratory equipment includes a large anechoic chamber, a small reverberation chamber and a multiple-unit acoustics laboratory for student experimentation in airborne acoustics. Sonar equipment, test and wave tanks and instrumentation for investigation in underwater sound comprise the underwater acoustics laboratory.

COURSE OFFERINGS

PH0110 REFRESHER PHYSICS (NO CREDIT). (Meets last 6 weeks of quarter) (5-3).
A six-week course of selected topics from elementary physics for incoming students. Typical subjects are kinematics, Newton's laws of motion, work, energy, linear and angular momentum. Vector algebra and some aspects of calculus are developed as needed and their use is emphasized. The two, ninety-minute laboratory periods are guided problem solving. PREREQUISITES: Previous college courses in elementary physics and integral calculus.

PH0499 ACOUSTICS COLLOQUIUM (NO CREDIT). (0-1)
Reports on current research and study of recent research literature in conjunction with the student thesis. PREREQUISITE: A course in acoustics.

PH0810 THESIS RESEARCH (0-0).
Every student conducting thesis research will enroll in this course.

PH0999 PHYSICS COLLOQUIUM (NO CREDIT) (0-1).
Discussion of topics of current interest by NPS and outside guest speakers.

PH1111 FUNDAMENTALS OF PHYSICS I: MECHANICS (4-2).
This course, intended for Engineering Science students, is offered whenever the combined enrollment in PH1111 and PH1121 is sufficiently large to offer more than one segment. It is identical to PH1121 except that it is taught at a pace at which the students can comfortably progress, with the result that somewhat less material may be covered than in PH1121. PREREQUISITE: A course in calculus (may be taken concurrently).

PH1121 PHYSICS I: MECHANICS (4-2).
Vector algebra, particle kinematics in one and two dimensions, Newton's laws of motion, particle dynamics, work and energy, conservation of energy, systems of particles, conservation of momentum, rotational kinematics and dynamics, gravitation, simple harmonic motion. PREREQUISITE: A course in calculus (may be taken concurrently).

PH1312 FUNDAMENTALS OF PHYSICS II: ELECTRICITY AND MAGNETISM (4-2).
This course, intended for Engineering Science students, is offered whenever the combined enrollment in PH1312 and PH1322 is sufficiently large to offer more than one segment. Topics covered are the same as in PH1322, but there are two hours of problem sessions each week rather than one. PREREQUISITE: PH1111 or PH1121 or equivalent.

PH1322 PHYSICS II: ELECTRICITY AND MAGNETISM (4-1).
Electric charge, Coulomb's Law, electric field, Gauss' Law, electrical potential and energy, capacitors and dielectrics, current and resistance, EMF and DC circuits, magnetic field, Ampere's Law, Faraday's Law, inductance, electromagnetic oscillations, AC circuits, Maxwell's Equations, electromagnetic waves. PREREQUISITE: PH1111 or PH1121 or equivalent.

PH1331 BASIC PHYSICS (4-0).
This course covers the fundamentals of mechanics, electromagnetic fields and waves. Designed to support the Intelligence and Space Systems Operations Curricula, it should nevertheless serve any student who has successfully taken a course in physics, (even in the dim past). PREREQUISITE: Elementary calculus (may be taken concurrently).

PH2001 PHYSICS THESIS OPPORTUNITIES (1-0).
This course is designed for students interested in choosing and pursuing a Master's thesis in physics. Members of the faculty of the Department of Physics having research projects suitable for Master's degree theses will give presentations on their projects. The course is given in the pass/fail mode. PREREQUISITES: At least 7-quarter hours of physics courses.

PH2012 PHYSICS LABORATORY I (3-2).
Introduction to data acquisition and analysis. Statistical analysis of data. Estimation and propagation of error. Graphical techniques of data presentation and linear regression analysis for linear and linearized two parameter functions. Distribution functions and hypothesis testing. Transduction, transfer functions and instrumentation. Sampling, digitization and their associated errors. Computer controlled data acquisition. PREREQUISITES: A course in basic physics and a course in calculus.

PH2013 PHYSICS LABORATORY II (2-2).
The second course in a two-quarter sequence on laboratory measurements and analysis techniques. Fourier analysis, signals in noise, phase sensitive detection, convolution and de-convolution, time windowing and averaging. PREREQUISITE: PH2012.

PH2119 OSCILLATION AND WAVES (4-2).
An introductory course designed to present mechanics to students studying acoustics. Kinematics, dynamics and work and energy consideration for the free, damped and driven oscillators. The wave equation for transverse vibration of a string, ideal and realistic boundary conditions and normal modes. Longitudinal and transverse waves in bars. Transverse waves on rectangular and circular membranes. Vibrations of plates. Laboratory periods include problem sessions and experiments on introduction to experimental techniques and handling of data; the simple harmonic oscillator analog; transverse waves on a string; and transverse, longitudinal and torsional waves on a bar. PREREQUISITES: Courses in differential equations and basic physics.

PH2151 MECHANICS I - PARTICLE MECHANICS (4-1).
After a review of the fundamental concepts of kinematics and dynamics, this course concentrates on those two areas of dynamics of simple bodies which are most relevant to applications in Weapon Systems Engineering: vibrations and projectile motion. Topics include: damped and driven oscillations, projectile motion with atmospheric friction, satellite orbits and rotating coordinate systems. PREREQUISITES: PH1121 or equivalent; MA2121 or equivalent course in ordinary differential equations (may be concurrent).

PH2203 TOPICS IN BASIC PHYSICS: WAVES AND OPTICS(4-0).
A course to provide physical background to wave motion, acoustics and optics for students in the Electronic Warfare Curriculum and to provide applications of analytical techniques to physical problems. Areas covered are harmonic motion-differential equations, complex notation, damped vibration and resonance; wave motion (properties of waves, sound waves, optics), geometrical and wave optics. PREREQUISITES: MA2138, MA2047; may be taken concurrently.

PH2207 FUNDAMENTALS OF ELECTRO-OPTICS (4-0).
This course is designed to provide students in interdisciplinary curricula with specific prerequisite background for electro-optics courses in those curricula. Topics discussed include: matrix formulation of optics, catoptric and catadioptric systems, diffraction, behavior of gaussian profile beams, Fourier optics and resolution, atmospheric transmission, atomic and molecular energy states, line shapes, band theory of semiconductors, the p-n junction, light emitting diodes, stimulated emission and lasers. PREREQUISITES: MA3139 and PH2304 (or equivalent).

PH2223 PHYSICS III: OPTICS (4-2).
Geometrical optics; reflection and refraction of rays at plane and spherical surfaces; mirrors, plane and spherical; lenses, thick lenses and lens aberration; matrix methods for thick lenses and lens systems. Physical optics, wave equation, phase and group velocity. Fourier transforms, interference, diffraction, polarization, birefringence. PREREQUISITES: PH1322 and a course in differential equations.

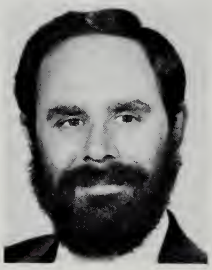
PH2304 TOPICS IN BASIC PHYSICS: ELECTROMAGNETISM (2-0).
This course follows PH2203 in the Electronic Warfare Systems curriculum. Basic concepts of electric and magnetic fields are introduced and their interaction with charges and currents discussed. The experimental laws are used to develop Maxwell's Equations and simple solutions to these equations are considered. The course is normally taught in a six-week period. PREREQUISITES: PH2203 or equivalent and mathematics through vector analysis and ordinary differential equations.

PH2351 ELECTROMAGNETISM (4-1).
Electrostatic fields in vacuum and dielectrics, Poisson's and Laplace's equations, electrostatic energy, electric current. The magnetic field of steady currents, Biot-Savart and Ampere's Laws, vector potential, magnetic properties of matter. Electromagnetic induction and Faraday's Law. Magnetic energy. Maxwell's Equations. PREREQUISITES: PH1322 or equivalent, MA2047 or equivalent.

PH2401 INTRODUCTION TO THE SONAR EQUATIONS (3-0).
A discussion of each term of the sonar equations, with application to the detection, localization and classification of underwater vehicles. Topics include ray acoustics, simple transmission loss models, tonals, spectrum and band levels, directivity index, array gain, doppler shift and detection threshold. This course is intended primarily for students in the Antisubmarine Warfare Curriculum and is given in a "structured" PSI mode. PREREQUISITE: Precalculus mathematics.

PH2410 ANALOG ELECTRONICS AND SIGNAL CONDITIONING FOR ACOUSTICS (3-2).
Applications of simple integrated circuits to acoustical measurements including op-amp filters and amplifiers, voltage controlled oscillators, D-to-A, A-to-D and frequency-to-voltage converters. Sources of noise (thermal and quantization) in electro-acoustic systems. Techniques of noise reduction in the frequency and time domains including signal integration and time averaging, digital and analog Fourier analysis, phase sensitive detection and time domain auto- and cross-correlation analysis. PREREQUISITES: PH2012 and EC2170.

PH2511 INTRODUCTION TO ORBITAL MECHANICS (4-0).
The gravitational two-body problem. Elliptic orbits and orbital elements. Orbital maneuvers and transfers. Time of flight. Ground track. Additional topics selected from the following: suborbital trajectories, hyperbolic trajectories, orbit determination from radar data and orbital perturbations. PREREQUISITES: A course in basic mechanics (including vectors) and a course in ordinary differential equations.



Steven Garrett
Professor, Physics

Professor Steven Garrett was hired by the Naval Postgraduate School nine years ago to do work in acoustics. “I came to NPS because it was the last place were acoustics was still considered to be physics,” says Garrett. “There must be over 20 acoustics courses given on a yearly basis, sometimes twice a year. If you want to study or teach acoustics, this is the place to come. We’ve cornered the market.”

Garrett is equally impressed by the students, their maturity and the interdisciplinary input they provide in his research. “I have access to students in various departments. They come here having real world experience. In fact, they’re sent here because they’re so good the Navy doesn’t want to lose them.

“At the moment, I have three major research programs: one in fiber optics sensing, one in thermoacoustic refrigeration and another in nonlinear wave dynamics. The administration has never discouraged me from working in fields outside of acoustics or from using a broad range of students — in physics, engineering acoustics and electrical engineering — in my program. This is extremely rare in academic institutions; most have a very narrow view of what physics is. NPS absolutely does not impose those artificial limitations.”

Garrett points out that there are no teaching assistants at NPS. “Because of this, the faculty teach the discussion sessions, run the labs and grade the papers. The work is very hard for the faculty, but it’s great for the students.”

He adds, “One more terrific thing about NPS that can’t be overlooked is that it’s on the Monterey Peninsula; it’s a good environment for living, raising a family and working.”

H2514 INTRODUCTION TO THE SPACE ENVIRONMENT Course number changed from PH3514 in June'90) (4-0).
lasma concepts. Solar structure and magnetic field, particle and lectromagnetic emissions from the sun, the geomagnetic field and the nagnetosphere; radiation belts, structure and properties of the arth's upper atmosphere, ionosphere, the effects of man in the space nvironment. PREREQUISITES: A course in basic electricity and nagnetism.

H2601 SURVEY OF MODERN PHYSICS (4-1).
his is a one-term course covering the fundamentals of modern hysics with selected applications. Topics include special relativity, he wave-particle duality, the Schrodinger equation, atoms and nolecules, lasers, semiconductors and superconductors. REREQUISITE: PH2223.

H2681 INTRODUCTORY QUANTUM PHYSICS (4-2).
pecial relativity plus the fundamental concepts of quantization in nodern physics. Topics include the Bohr atom, blackbody radiation, ave-particle duality, the Schroedinger equation and its application o potential barriers and wells and to the harmonic oscillator and the ydrogen atom. Also the Pauli exclusion principle, spin and angular nomentum. PREREQUISITE: PH2223. A Course in theoretical hysics (PH3990) desirable but not mandatory.

H2724 PHYSICS IV: THERMODYNAMICS (4-0).
quations of state; the concepts of temperature, heat and work; the irst law of thermodynamics; heat engines and refrigerators; entropy nd the second law of thermodynamics; thermodynamics potentials; hase equilibrium; kinetic theory; equipartition theorem; transport henomena. PREREQUISITES: PH1121 and a course in multivariable alculus.

H2911 INTRODUCTION TO COMPUTATIONAL PHYSICS (2-2).
n introduction to the role of computation in modern physics, with mphasis on the programming of current physics problems. Includes n introduction to mainframe operations in both the time-sharing and atch environments. Algorithmic design and structured programming ill be emphasized. Exercises, chosen to emphasize physical bjectives, will be assigned in FORTRAN. PREREQUISITE: A Basic hysics course.

H3002 NON-ACOUSTIC SENSOR SYSTEMS (4-0).
his course covers the physical principles underlying the operation of number of operational and proposed non-acoustic sensor systems. eomagnetism, magnetometers and gradiometers, MAD signatures, ptical and IR transmission in the atmosphere and in sea water. mage Converter, FLIR and radar systems for ASW. Exotic detection chemes. PREREQUISITES: PH3360, EO3720 and SECRET learance.

H3006 WEAPONS SYSTEMS AND WEAPONS EFFECTS (4-0).
his course will cover technical aspects of three areas of modern eapons systems: Nuclear weapons and effects on personnel, quipment and structures; principles of directed energy weapon oncepts and their interactions with targets; space based defense ystem concepts. PREREQUISITE: SE3301 or equivalent.

PH3152 MECHANICS II - EXTENDED SYSTEMS (4-1).
The principles of dynamics are applied to real extended bodies. Topics include: principles of rocket propulsion, rotational motion of axisymmetric bodies and its application to projectile spin and gyroscopic motion. An introduction to generalized methods of description of dynamic systems is given and the general behavior of complex vibrating systems is studied. PREREQUISITE: PH2151.

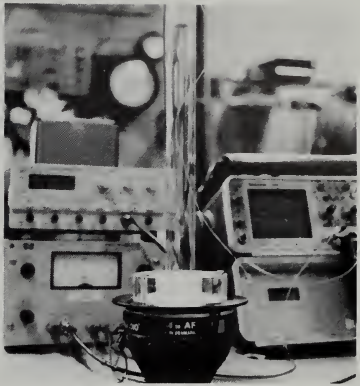
PH3161 FLUID DYNAMICS (4-1).
This course emphasizes the dynamics of real compressible fluids. The basic properties of fluids are introduced and the concepts of fluid kinematics, stress and strain are discussed. Both the control volume and differential equation approaches are applied to the flow of viscous fluid. The laws of similarity are developed and the significance of Reynolds, Fraude and Mach number discussed. Topics covered include laminar and turbulent flow, isentropic subsonic channel flow, supersonic flow in nozzles and two-dimensional supersonic flow. PREREQUISITE: PH2151 or equivalent.

PH3166 PHYSICS OF UNDERWATER VEHICLES (4-2).
This course emphasizes the dynamics of real incompressible liquids. The basic properties of fluids are introduced and the concepts of fluid kinematics, stress and strain are discussed. Both the control volume and the differential equation approaches are applied to the flow of a viscous fluid. The laws of similarity are developed and the significance of Reynolds, Fraude and Mach numbers are discussed. Topics covered include laminar flow, turbulent flow, boundary layer theory and the calculation of lift and drag. One or more special topics may be discussed (surface waves, cavitation and the fluid-dynamic generation of sound) depending upon the interests of the instructor and students. PREREQUISITE: PH2151 or equivalent.

PH3208 ELECTRO-OPTIC PRINCIPLES AND DEVICES (4-1).
This course is designed to provide students in inter-disciplinary programs with a general understanding of the principles and capabilities of the component devices comprising military electro-optic and infrared systems. Topics treated include: atmospheric extinction, turbulence, thermal blooming and breakdown, adaptive optics, thermal radiation, target signatures, backgrounds, electro-optic and acousto-optic devices, reticles and other trackers, detector characteristics, noise and cooling, television, CCD, CID and scanning imagers. Laboratory work provides hands-on familiarity with these devices. This course is taught in a six-week period. PREREQUISITES: PH2203, PH2207, MA3139 or equivalent.

PH3252 ELECTRO-OPTICS (4-0).
This course treats the properties of electro-optic systems together with the basic physical principles involved. Topics included are: diffraction and Fourier transform methods; optical data processing; Fresnel equations, evanescent waves, film and fiber optics; Gaussian beams and laser resonators; molecular spectra, transition probability, line widths and laser gain; specific lasers, Q-switching and mode locking; semi-conductors, junction diodes, photodetection, light emitting diodes and diode lasers. PREREQUISITES: PH3352, PH3683.

PH3352 ELECTROMAGNETIC WAVES (4-0).
Maxwell's equations. Energy density and Poynting vector, boundary conditions. Polarization. Propagation of uniform plane waves in vacuum, dielectrics, conducting media (with emphasis on sea water) and low-density neutral plasmas. Reflection and refraction at plane dielectric and conducting boundaries, at normal and oblique incidence. Rectangular wave guides. PREREQUISITE: PH2351.



PH3360 ELECTROMAGNETIC WAVE PROPAGATION (4-1).
Introduction to vector fields and the physical basis of Maxwell's equations. Wave propagation in a vacuum, in dielectrics and conductors and in the ionosphere. Reflection and refraction at the interface between media. Guided waves. Radiation from a dipole. PREREQUISITES: MA2121 and a course in basic electricity and magnetism.

PH3402 UNDERWATER ACOUSTICS (4-1).
The third of a four-course sequence in acoustics for students in the ASW curriculum, this course is an analytical study of those aspects of underwater sound that influence the sonar equations. Topics include: The wave equation in fluids; acoustic properties of fluids; plane, spherical and cylindrical waves; absorption of sound in sea water; simple sources; transducer properties and sensitivities; surface interference; three-element array; normal and oblique incidence reflection and transmission at boundaries; image theory and the shallow-water channel; continuous line source and the plane circular piston; radiation impedance; linear arrays with steering; the Eikonal Equation and ray theory. Laboratory experiments include advanced acoustic instrumentation, longitudinal waves in an air-filled tube, surface interference, properties of underwater transducers and the 3-element array. PREREQUISITES: PH2119 or equivalent and PH2401.

PH3410 FIBER-OPTIC SYSTEMS FOR ACOUSTICS (3-2).
Introduction to the physics of electro-optical sources (lasers and LED's) and photodetectors and the principles of light propagation in optical fibers. Fiber-optic communication system considerations including component specification, data rates and power budget. Introduction to fiber-optic sensor systems. PREREQUISITES: PH2410, PH3360 and EC2500.

PH3451 FUNDAMENTAL ACOUSTICS (4-2).
Development of and solutions to, the acoustic wave equation in fluids. Propagation of plane, spherical and cylindrical waves in fluids, sound pressure level, intensity and specific acoustic impedance. Normal and oblique incidence reflection and transmission from plane boundaries. Transmission through a layer. Image theory and surface interference. Sound absorption and dispersion for classical and relaxing fluids. Acoustic behavior of sources and arrays, acoustical reciprocity, continuous line source, plane circular piston, radiation impedance and the steered line array. Transducer properties, sensitivities and calibration. Laboratory experiments include longitudinal waves in an air-filled tube, surface interference, properties of underwater transducers, three-element array, speed of sound in water and absorption in gases. PREREQUISITES: PH2119 and PH2724.

PH3452 UNDERWATER ACOUSTICS (4-2).
This course is a continuation of PH3451. Lumped acoustic elements and the resonant bubble. Introduction to simple transducers. Normal modes in rectangular and cylindrical enclosures. Steady-state response of acoustic waveguides of constant cross section, propagating evanescent modes and group and phase speeds. Transmission of sound in the ocean, the Eikonal Equation and necessary space conditions for ray theory and refraction and ray diagrams. Sound propagation in the mixed layer, the convergence zone and the deep sound channel. Passive sonar equation, ambient noise and doppler effect and bandwidth considerations Active sonar equations, target strength and reverberation. Laboratory experiments include Helmholtz resonators, normal modes in rectangular, cylindrical and spherical enclosures, water-filled waveguide, noise analysis, impedance of a loudspeaker. PREREQUISITE: PH3451

PH3458 NOISE, SHOCK AND VIBRATION CONTROL (4-0).
The application of the principles of acoustics and mechanics to the problems of controlling noise, vibration and mechanical shock. Topics include linear mechanical vibrations; introduction to vibrations of nonlinear systems; damping mechanisms; vibration and shock isolation; noise generation and control; effects of noise on man; application to problems of Naval interest such as ship quieting and industrial noise control. PREREQUISITE: A course in acoustics.

PH3461 EXPLOSIVES AND EXPLOSIONS (4-0).
Explosives terminology; thermochemistry of explosive decomposition; the detonation state; explosives safety. Generation and propagation of explosive shock waves in air; Rankine-Hugoniot equations; scaling laws; normal, oblique and Mach reflection. Dynamic blast loads and corresponding structure response. PREREQUISITE: PH2724 or equivalent.

PH3479 PHYSICS OF UNDERWATER WEAPONS (4-0).
The basic physics of underwater weapons from launch through explosion are addressed using a modern acoustic torpedo to illustrate practical applications. Topics include initial inputs, water entry, power plants, propulsors, drag and drag reduction, stability and control, guidance, acoustic search, terminal homing, exploders and explosions. An historical summary of U.S. torpedoes and depth charges and a review of current NATO and Soviet torpedoes are also presented. PREREQUISITES: A course in acoustics and a SECRET NOFORN clearance.

PH3513 INTERMEDIATE ORBITAL MECHANICS
(Variable hours 2-0 to 4-0) (V-0).
Orbital perturbations due to various sources, such as atmospheric drag and lunar tidal effects. Interplanetary trajectories. Additional topics depending on hours assigned to course. PREREQUISITE: PH2511.

PH3516 SPACECRAFT-ENVIRONMENT INTERACTIONS (3-0).
The interactions between satellites and their environment as they apply to the design and operation of satellites. These interactions include neutral gas drag and debris, electrical effects of energetic plasmas and radiation effects due to particles. Physical interactions are emphasized, leading to an understanding of the impact of operating systems. PREREQUISITE: PH2514.

PH3683 INTERMEDIATE QUANTUM PHYSICS (4-1).
Applies the fundamental concepts of quantum physics to the development and application of theoretical methods for dealing with real systems. Topics covered: Orthogonal expansions, time independent and time dependent perturbation theory. Helium and multi-electron atoms and spectra. The periodic table, diatomic molecules, lasers, solids and semiconductors. PREREQUISITES: PH2681 and PH3990.

PH3782 THERMODYNAMICS AND STATISTICAL PHYSICS (4-0).
Entropy, temperature, Boltzmann factor and Gibbs factor are developed from a quantum point of view. Blackbody radiation, chemical potential, partition function, Gibbs sum and applications to an ideal gas are covered. Fermi-Dirac and Bose-Einstein statistics and applications to degenerate systems. Gibbs free energy, Helmholtz free energy, enthalpy, kinetic theory, phase transformations, chemical reactions. PREREQUISITE: PH2681.

PH3855 NUCLEAR PHYSICS (4-2).
This is the first in a sequence of graduate specialization courses on nuclear weapons and their effects. This course deals with the necessary underlying principles of nuclear physics, including nuclear forces, models, stability, reactions and decay processes and interaction of high energy particles with matter. The laboratory includes radiation detection techniques and statistics of counting. PREREQUISITES: PH3152, PH3360 and PH3683 or equivalents.

PH3911 SIMULATION OF PHYSICAL SYSTEMS (3-1).
Comparisons between simulation, theory and experimentation as techniques of scientific investigation. Computer simulation methodology and techniques: Monte Carlo and deterministic simulations, variance reduction and analysis of results. Applications from physics and/or weapons performance. There is a one-hour applications laboratory. PREREQUISITE: MA3400, or OS3602, or consent of instructor.

PH3921 NONLINEAR DYNAMICS, CHAOS, FRACTALS AND ALL THAT (Variable hours 2-0 to 3-0) (V-0).
The existence of chaotic dynamics has been discussed in the literature for many decades and is associated with names like Poincare, Birkhoff, Kolmogorov and others. However, it is only recently that the wide ranging impact of chaos has been recognized. The field is undergoing explosive growth and many applications have been made across a broad spectrum of scientific disciplines - ecology, economics, physics, chemistry, engineering and fluid mechanics. Much effort is driven by the hope that it may be possible to find unifying principles that characterize and classify large classes of nonlinear complex systems. This course is an introduction into the concepts and the language used in this rapidly growing exciting field from a physicist's point of view. PREREQUISITE: PH2151 or equivalent.

PH3990 METHODS OF THEORETICAL PHYSICS (4-0).
A selection of mathematical techniques applied to specific problems drawn from physical systems, such as classical waves, scattering, electrodynamics, resonant cavities, incompressible flow, dielectric and magnetic media, heat conduction, Fourier optics and quantum mechanics. Topics may include complex variables, series solutions of differential equations, Fourier analysis and Green's functions. PREREQUISITES: MA2089, MA2121 and a sequence of courses in basic physics.

PH3998 SPECIAL TOPICS IN INTERMEDIATE PHYSICS (Variable hours 1-0 to 4-0) (V-0).
Study in one of the fields of intermediate physics and related applied areas selected to meet special needs or interests of students. The course may be conducted as a seminar or supervised reading in different topics. PREREQUISITES: A 2000-level course appropriate to the subject to be studied and consent of the Department Chairman. The course may also be taken on a Pass/Fail basis provided the student has requested so at the time of enrollment.

PH4054 PARTICLE BEAM AND HIGH ENERGY LASER WEAPON PHYSICS (4-0).
This course is an in-depth study into the beam weapon concepts. Topics covered are: relativistic electron beams; their equilibrium, propagation losses and stability; giant power accelerator concepts; target interaction; proton beams; neutral particle beams, their production and limitations; high power microwave beams, high energy laser beams, their production, atmospheric propagation and control and their interaction with targets. PREREQUISITES: PH3352, PH2151 or equivalent courses in electromagnetism and mechanics. SECRET clearance.

PH4162 MECHANICS OF CONTINUA (3-0).
The foundations of fluid mechanics presented in the tensor formulation. Scalars, vectors and tensors. Tensor differential and integral calculus. The stress tensor and rate of deformation tensor. Principal values, deviators and other invariants. Fundamental laws: conservation of mass, linear momentum, angular momentum and energy. Constitutive equations. Non-Newtonian fluids. Visco-Plastic materials. PREREQUISITE: PH3161 or equivalent.

PH4209 EO/IR SYSTEMS AND COUNTERMEASURES (3-2).
This unclassified course for students in interdisciplinary curricula treats the military applications of electro-optic systems, including IR and EO seekers and trackers, surveillance and missile warning systems and laser rangers and designators. Scanning FLIR and IRST systems and array applications will be included. Signature suppression and generic active and passive countermeasure approaches will be discussed. Laboratory work will deal with EO/IR devices and possible countermeasure techniques. PREREQUISITES: PH3208 and MA3139.

PH4253 SENSORS, SIGNALS and SYSTEMS (4-2).
This course treats the physical phenomena and practical problems involved in sensor systems for electromagnetic signals in the EO/IR range. Topics included are: optical modulation, nonlinear optics, acousto-optics; atmospheric molecular absorption characteristics and mechanisms of detectors for optical and infrared radiation, noise in detectors, cooling systems; image intensifiers, television and FLIR systems; detecting,tracking and homing systems; signal sources, target signatures and backgrounds; laser target designators, laser radars, the range equation. The laboratory will include experiments related to this material as well as to that of the preceding course, PH3252. PREREQUISITES: PH3252 and a course in electromagnetism.

PH4254 THERMAL IMAGING AND SURVEILLANCE SYSTEMS (4-0).

This course is intended as a capstone course to follow the sequence PH3252 and PH4253, or the sequence PH2207 and PH3208. It will address the system analysis and technology of infrared imaging and search/track systems, including the derivation of system performance measures such a Minimum Detectable Temperature Difference, (MDT) and Minimum Resolvable Temperature Difference (MRTD) in terms of the optics, scanner, detectors, display and human operator characteristics. Performance Predication codes and Tactical Decision Aids (TDAs) will be analyzed for current Forward Looking Infra Red (FLIR) Systems and comparable codes for IRSTs discussed. Criteria for target detection and transference of contrast will be compared. Integrated Focal Plane Array Technology will be explored for application to second generation FLIR and Staring Imager development. PREREQUISITE: PH3208 or PH4253 or consent of instructor.

PH4283 LASER PHYSICS (4-0).

The physics of lasers and laser radiation. Topics will include: spontaneous and stimulated emission, absorption, interaction of radiation with matter, line broadening mechanisms, optical and electrical pumping, gain, properties of laser beams. Gaussian beams, stable and unstable resonators, rate equations, output coupling, mode locking, short pulsing, specifics of solid state and gas laser systems, high energy and high power lasers, laser-surface interaction, air breakdown, laser supported detonation waves, laser isotope separation and laser fusion. PREREQUISITE: PH3252 or equivalent, or consent of instructor.

PH4353 TOPICS IN ADVANCED ELECTRICITY AND MAGNETISM (4-0).

Topics selected from electromagnetic radiation, including radiation from antennas and accelerating particles and radiation scattering from charged particles. Additional topics may include Cerenkov radiation, free electron lasers and the relativistic formulation of electrodynamics. PREREQUISITES: PH3152, PH3352 and PH3990.

PH4371 CLASSICAL ELECTRODYNAMICS (3-0).

Tensors in special relativity. Classical relativistic electromagnetic field theory. Lorentz electron theory. PREREQUISITES: PH4353 and familiarity with the special theory of relativity and Lagrangian mechanics.

PH4403 ADVANCED TOPICS IN UNDERWATER ACOUSTICS (4-1).

The last in a sequence of courses in acoustics for students in the ASW curriculum, this course is a continuation of PH3402. Topics include: Review of the sonar equations, normal modes in enclosures, steady-state response of isospeed acoustic waveguides, propagating and evanescent modes, group and phase speeds, the wave equation with a source term, the point source in cylindrical coordinates, transmission loss models for isospeed shallow water channel with fluid bottom, the parabolic equation and the parametric array. Laboratory experiments include analysis of underwater noise, normal modes in a rectangular cavity and acoustic waveguides. PREREQUISITE: PH3402 or equivalent.

PH4410 ADVANCED ACOUSTICS LABORATORY (1-6).
Advanced laboratory projects in acoustics. Through the performance of experiments drawn from diverse fields of acoustics, the student is introduced to the problems and opportunities of acoustics research. For each experiment the student is guided through the scientific literature on the subject, the construction of the equipment, the collection and analysis of the data and the writing of a research report. PREREQUISITE: PH3452.

PH4453 SCATTERING AND FLUCTUATION OF SOUND IN THE OCEAN (4-0).
An advanced treatment of the effects of variations of the ocean and its boundaries on ocean noise and the scattering and fluctuation of sound. Topics include: multipole radiation fields and noise sources in the sea, coherence and incoherence, probability density functions, the Hemholtz integral and general scattering formalism, scattering from objects, correlations and frequency spectra of sound scattered from rough boundaries, fluctuations associated with variability in the medium. PREREQUISITE: PH3452 or consent of the instructor.

PH4454 TRANSDUCER THEORY AND DESIGN (4-2).
A treatment of the fundamental phenomena basic to the design of transducers for underwater sound, specific examples of their application and design exercises. Topics include piezoelectric, magnetostrictive and hydromechanical effects. Laboratory includes experiments on measurement techniques, properties of transducer materials, characteristics of typical transducer types and a design project. PREREQUISITE: PH3452 (may be taken concurrently).

PH4455 SOUND PROPAGATION IN THE OCEAN (4-0).
An advanced treatment of the subject. Topics include; reflection of spherical waves from ocean boundaries; normal mode propagation of sound; inhomogeneous wave equation and the point source in cylindrical coordinates; shallow water channel with fluid and solid bottoms; the deep sound channel and the WKB approximation; range-dependent channels; adiabatic normal modes and the parabolic equation; multi-path propagation. Application to Arctic Ocean acoustics. PREREQUISITE: PH4453 or consent of instructor.

PH4456 SEMINAR IN APPLICATION OF UNDERWATER SOUND (3-0).
A study of current literature on application of acoustics to problems of Naval interest. PREREQUISITE: PH3402 or PH3452 or PH4403 or consent of the instructor.

PH4459 SHOCK WAVES AND HIGH-INTENSITY SOUND (3-0).
Nonlinear oscillations and waves on strings. The nonlinear acoustic wave equation and its solution. The parametric array. The physics of shock waves in air and in water. PREREQUISITE: PH3451.

PH4515 PHYSICS OF THE SATELLITE ENVIRONMENT (3-0).
A graduate-level treatment of the structure and properties of the near earth space environment and some aspects of solar physics. Topics (usually two per quarter) are chosen from: ionospheric composition, ionospheric radio wave propagation, structure of the magnetosphere, the geomagnetic field, solar structure and emissions. PREREQUISITES: PH2514 and a 3000-level course in electromagnetism. Some background in plasma physics is desirable.

PH4531 INTRODUCTION TO ASTROPHYSICS (4-0).

Introduction to theories of stellar structure, energy transport in stars and stellar evolution. Recent advances in solar physics. Supernovae, pulsars, black holes and the origin of the universe will be topics of discussion. PREREQUISITES: PH3152 and PH3352.

PH4661 PLASMA PHYSICS I (4-0).

This course constitutes a broad study of the behavior and properties of gaseous plasma, the fourth -- and most abundant -- state of matter in the universe. Plasma physics is a vigorously developing branch of contemporary physics. Its many applications are in areas such as astro and space-physics, atomic physics, magneto-hydrodynamic power generation, electron beam excited laser, laser isotope enrichment, ionospheric communication, thermonuclear fusion and high energy beam weapons. The physical concepts fundamental to various branches of plasma physics are introduced. Topics covered include single particle motions in electromagnetic fields, orbit theory, collision phenomena, breakdown in gases and diffusion. The magneto-hydrodynamic and the two-fluid plasma models are considered. PREREQUISITE: PH3360 or the equivalent.

PH4662 PLASMA PHYSICS II (3-0).

A continuation of Plasma Physics I. Applications of the hydromagnetic equations to the study of macroscopic motions of plasma. Equilibrium and stability. Classification of plasma instabilities. Kinetic theory, the Boltzmann equation and the macroscopic-momentum transport equation. Plasma oscillations and Landau damping. Nonlinear effects, shock waves, radiations from plasma, including bremsstrahlung and cyclotron radiation. Controlled fusion and laser-produced plasmas. PREREQUISITES: PH4661 or consent of instructor.

PH4663 ADVANCED PLASMA PHYSICS (3-0).

Selected topics in plasma physics, such as laser-target interaction, dynamics of a laser-produced plasma, self-generated magnetic fields, plasma surface interactions, unipolar arcing, plasma opening switch. PREREQUISITE: PH4662 or consent of instructor.

PH4750 SOLIDS AND RADIATION EFFECTS (4-0).

An introduction to solid state physics and radiation effects. Free electron theory, bands, semiconductors and lattice structure are discussed. Radiation damage mechanisms, TREE and hardening concepts are introduced. PREREQUISITES: PH3352 and PH3683.

PH4760 SOLID STATE PHYSICS (4-0).

Fundamental theory dealing with solids: crystals, binding energy, lattice vibration, dislocations and mechanical properties, free electron theory, band theory, properties of semi-conductors and insulators, and magnetism. PREREQUISITES: PH3683 and PH3782 (the latter may be taken concurrently).

PH4771 STATISTICAL PHYSICS I (3-0).
Kinetic theory and the Boltzmann theorem, configuration and phase space, the Liouville theorem, ensemble theory, microcanonical, canonical and grand canonical ensembles, quantum statistics. PREREQUISITES: PH3152, PH3683 and PH3782.

PH4772 STATISTICAL PHYSICS II (3-0).
A continuation of PH4771 with applications to molecules, Bose-Einstein gases, Fermi-Dirac liquids and irreversible processes. PREREQUISITE: PH4771.

PH4783 ADVANCED STOCHASTIC PHYSICS (3-0).
Stochastic physics deals with nonlinear nonequilibrium statistical mechanics, often using and generalizing methods and concepts of equilibrium statistical physics. The interplay between deterministic and random forces to generate organization, especially in large-scale systems, will be studied using methods of solution of multivariate rate equations and some use of their representations as diffusion systems. Specific applications will be stressed; e.g., to physical systems such as lasers. PREREQUISITE: PH3782 or PH3990.

PH4856 PHYSICS OF NUCLEAR EXPLOSIONS (4-0).
This second course in the nuclear weapons effects graduate specialization sequence considers in-depth questions of weapon designs and their specific output environments which are created by the nuclear explosion. Topics are: principles affecting weapon yield efficiency; explosion phenomenology in various ambient environments, blast and shock, thermal radiation, X-rays and gamma rays, neutron fluxes, electromagnetic pulse, radioactive fallout models. PREREQUISITES: PH3855 and SECRET clearance.

PH4857 RADIATION HYDRODYNAMIC TRANSPORT THEORY (4-0).
This course collects in systematic fashion most of the physical ingredients of the large Radiation-Hydrodynamic Computer Codes for nuclear weapon development, nuclear explosion phenomena, particle beam transport and beam-target interaction. Topics are: Boltzmann transport equation, general theory of transport processes in multi-component gases with reactions and ionization; radiation transport theory; opacity models; shock front structure. PREREQUISITES: PH4856 and SECRET clearance.

PH4881 ADVANCED NUCLEAR PHYSICS (3-0).
Topics according to the interests of students and instructor. PREREQUISITE: PH3855 or equivalent.

PH4911 WEAPON SYSTEMS SIMULATIONS (1-2).
Critical design parameters in the development of complex modern weapon systems are often determined by computer simulation of weapon system effectiveness in various physical environments and combat scenarios. In this course, the principles and techniques of a particular weapon system simulation will be studied and hands-on experience will be gained in the use of a simulation for design parameter sensitivity studies. PREREQUISITE: PH3911 or equivalent.

PH4971 QUANTUM MECHANICS I (3-0).
Review of Lagrange's and Hamilton's equations of motion. Poisson brackets. General principles of non-relativistic quantum mechanics; stationary states. PREREQUISITES: PH2681 and PH3152.

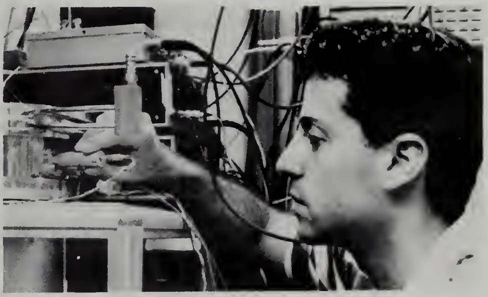
PH4972 QUANTUM MECHANICS II (3-0).
Addition of angular momenta; scattering theory; additional topics of interest to students and instructor. PREREQUISITE: PH4971.

PH4973 QUANTUM MECHANICS III (3-0).
General principles of relativistic quantum mechanics. Properties and solutions of relativistic wave equations. PREREQUISITES: PH4371 and PH4971.

PH4984 ADVANCED QUANTUM PHYSICS (4-0).
Quantum mechanics in the Dirac format. Angular momentum, spin, spin resonance. Additional topics may include group theoretical applications to selection rules and crystal fields, variational principles, self-consistent fields in the many-electron atom, scattering theory and polyatomic molecules. PREREQUISITES: PH3152 and PH3683.

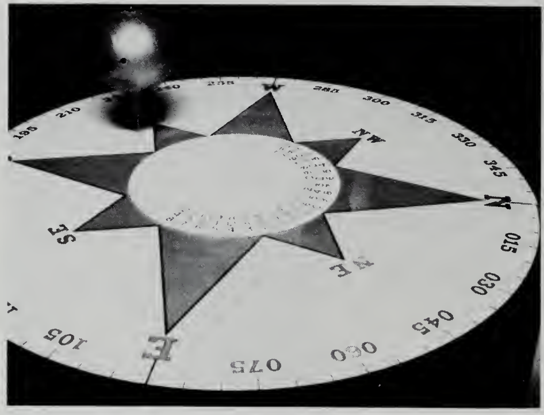
PH4991 RELATIVITY AND COSMOLOGY (3-0).
Einstein's general theory of relativity. The three classical tests. The Schwarzchild singularity and black holes. Cosmological models and their relations with observations. Introduction to modern developments; gravitational waves, problems of quantum cosmology and superspace. PREREQUISITE: PH4371.

PH4998 SPECIAL TOPICS IN ADVANCED PHYSICS (Variable hours 1-0 to 4-0) (V-0).
Study in one of the fields of advanced physics and related applied areas selected to meet special needs or interests of students. The course may be conducted as a seminar or supervised reading. The course carries a letter grade and may be repeated in different topics. PREREQUISITES: A 3000-level course appropriate to the subject to be studied and consent of the Department Chairman. It may also be taken on a Pass/Fail basis if the student has requested so at the time of enrollment.



SE3004 WEAPONS SYSTEM ANALYSIS (4-0).
This course is designed to support the Intelligence Curriculum. It treats the behavior of weapons systems as influenced by the physical properties of the environment and the physical properties of the devices incorporated into the systems. The course material includes: principles of electronic reconnaissance, antennas and their characteristics, factors affecting receiver sensitivity, transmission range, radar principles, the radar equation, optics fundamentals, infrared nomenclature, principles and elements of photographic science, electro-optical systems (with some background in semiconductors), sonar and non-acoustic ASW (Antisubmarine Warfare). PREREQUISITE: PH1331 or equivalent.

SE3301 RADIATING SYSTEMS (4-0).
This course for students of Operations Research and other Weapon System oriented non-engineering curricula discusses the physical principles exploited by information gathering systems with emphasis on general capabilities and limitations. After a general introduction to wave propagation, topics of discussion are electromagnetic waves, radar, electro-optics including lasers and underwater sound. These topics will be applied to specific systems such as missile guidance, sonobouys and phased arrays as appropriate to the class and instructor. PREREQUISITE: MA1116 or equivalent may be taken concurrently, or by consent of instructor.



SE4006 TECHNICAL ASSESSMENT OF WEAPON SYSTEMS (4-0).
This course is designed to support the Intelligence Curriculum. Current technical trends in weapon system technologies which are expected to significantly affect warfare are investigated. Topics covered are: nuclear weapons and their effects, nuclear strategic balance, satellite orbits, directed energy weapon concepts (SDI), future weapon concepts. PREREQUISITES: SE 3004 or equivalent and SECRET clearance.

SE4858 NUCLEAR WARFARE ANALYSIS (4-0).
This final course in the nuclear weapons effects graduate specialization sequence deals with technical aspects of strategic and tactical nuclear war. Effects which nuclear weapons explosion environments have on various defense platforms and systems are considered together with methods of hardening to reduce system vulnerability in each of the effected areas: blast and shock, thermal radiation, transient effects on electronics. EMP, biological effects from contamination, atmospheric and ionospheric effects on communication, detection and surveillance systems. PREREQUISITES: PH3461, PH4856 and SECRET clearance.

SPACE SYSTEMS ACADEMIC GROUP

The Space Systems Academic Group is an interdisciplinary association of faculty, consisting of twelve members representing eight separate academic disciplines. An academic group is a less formal organization than an academic department and each professor in the group has an appointment in an academic department. The Space Systems Academic Group has administrative responsibility for the academic content of the Space Systems Operations and the Space Systems Engineering programs of study. Teaching in these interdisciplinary programs is carried out by faculty members attached to the following academic departments: Administrative Sciences, Aeronautics and Astronautics, Electrical and Computer Engineering, Mathematics, Meteorology, Oceanography, Operations Research and Physics. Thesis topics for students in this area of study are approved by the group and the final thesis is approved by the group Chairman in addition to the academic department granting the degree (if any).

Chairman:
Rudolf Panholzer,
Professor,
Code 72, Bullard Hall,
Room 205,
(408) 646-2278,
AV 878-2278.

GROUP FACILITIES

To provide laboratory experience several facilities have been developed in cooperation with other academic departments.

1) Solar Simulation Facility
2) Flash X-Ray Facility
3) Electron Linear Accelerator
4) Navigational Satellite Receiver Laboratory
5) Small Satellite Test and Development Laboratory
6) Virbro-Acoustic Test and Measurement Facility
7) Access to the Secured Computing Facility for classified research and theses work.

DEGREE REQUIREMENTS

The Space Systems Engineering students earn a master's degree in one of the following academic departments: Aeronautics and Astronautics, Computer Science, Electrical and Computer Engineering, Mechanical Engineering, Physics or Mathematics. Refer to degree requirements for the listed departments.

The Space Systems Operations students are awarded the degree Master of Science in Systems Technology (Space Systems Operations). A minimum of 45-quarter hours of graduate level work of which at least 15 hours must represent courses at the 4000 level. Graduate courses in at least four different academic disciplines must be included and in two disciplines, a course at the 4000 level must be included. Space Systems Operations curriculum has a series of space-unique and/or space-oriented courses. These required courses fulfill the requirements of three courses constituting advanced study in an area of specialization. Each student is required to write a thesis which is space oriented. The study program must be approved by the Chairman of the Space Systems Academic Group.

COURSE OFFERINGS

SS0810 THESIS RESEARCH (0-0).
Every student conducting thesis research enrolls in this course.

SS2001 INTRODUCTION TO SPACE (4-0).
An overview of space science, technology and policy with emphasis on topics of military interest. Topics usually included are: Space Environment, Orbital Mechanics, Directed Energy Techniques, Space Power Systems, Guidance and Control, Communications, Propulsion and Launch Vehicles, U.S. and Soviet Space Policy and Organization.

Upper Division or Graduate Courses

SS3001 MILITARY APPLICATIONS OF SPACE (4-0).
Examination of the military functions which utilize space systems and the capabilities of current systems, impact of space operations on military strategy, doctrine and tactics. National space policy and national organizations involved in space policy, DOD and service relationships. Tasking and use of space systems and ground support elements and techniques to reduce vulnerability. Impact of current R&D programs. Requires SECURITY clearance.

SS3035 MICROPROCESSORS FOR SPACE APPLICATIONS (3-2).
Same as MA3035, except for an additional hour deemed necessary to include space-oriented applications. An introduction to microprocessors at the hardware/software interface. Machine language programming, assembly language programming, connecting and controlling peripherals (terminal, disc drive...), operating systems.

SS3525 AIR/OCEAN REMOTE SENSING FOR INTERDISCIPLINARY CURRICULA (4-2).
Principals of radiative transfer and satellite sensors, and methods used to measure the atmosphere and ocean; visual, infrared and microwave radiometry and radar systems. Laboratory sessions illustrate lecture concepts using interactive displays of satellite data. Course designed for Space Operations, Space Systems Engineering, Anti-Submarine Warfare, Underwater Acoustics and other interdisciplinary curricula. PREREQUISITES: Undergraduate physics, and differential/integral calculus and ordinary differential equations; or consent of instructor.

SS3900 SPECIAL TOPICS IN SPACE SYSTEMS (Variable).
Directed study either experimental or theoretical in nature. PREREQUISITE: Consent of the Chairman of Space Systems Academic Group and instructor. May be taken on Pass/Fail basis if the student has requested so at the time of enrollment.

Graduate Courses

SS4000 SPACE SYSTEMS SEMINARS AND FIELD TRIPS (0-1).
Seminars consist of lectures to provide perspective on Space Systems. Field trips expose the student to various space activities such as industry, NASA and DOD laboratories and commands.

SS4001 DECISIONS AND SPACE SYSTEMS (4-0).
Cost-Performance Analysis including mission analysis, measures of performance and cost models. Study of the evolution of the interaction of technology, economics and politics in determining space-related activities. Discussion of the militarization of space. PREREQUISITES: SS3001, OS3008, MN3301, TOP SECRET clearance with eligibility for SI/SAO. U.S. citizenship.

SS4002 MILITARY OPERATIONS IN SPACE (4-0).
Operation of space systems to achieve mission objectives. Periods of vulnerability. Launch windows. Satellite defense: hardening, maneuver, encryption, covert spores, etc. ASAT operations, Launch windows. Weapons in space and threats to space systems. PREREQUISITE: SS4001, OS3603, TOP SECRET clearance with eligibility for SI/SAO. U.S. citizenship.

SS4900 ADVANCED STUDY IN SPACE SYSTEMS (Variable).
Directed graduate study based on journal literature, experimental projects or other sources. PREREQUISITE: Consent of the Chairman of Space Systems Academic Group and instructor. May be taken on Pass/Fail basis if the student has requested so at the time of enrollment.

FLIGHT
WILL ATF BE BUILT?

DEFENSE RESOURCES MANAGEMENT EDUCATION CENTE

Ralph W. West, Jr., Rear Admiral, U.S. Navy; Director (1989)*.

James Sherman Blandin, Professor (1974); Executive Director; PhD, University of Oregon, 1974.

Donald E. Bonsper, Adjunct Professor (1982); MS, Naval Postgraduate School, 1970.

Robert Edward Boynton, Associate Professor (1970); PhD, Stanford University, 1968.

James M. Bradney, Lieutenant Colonel, U.S. Air Force; Instructor (1990); MS, Air Force Institute of Technology, 1980.

Earl R. Brubaker, Professor (1983); PhD, University of Washington, 1964.

Gregory A. Correa, Lieutenant Colonel, U.S. Army; Instructor (1990); MBA, Chaminade University, 1980.

Philip Atkins Costain, Adjunct Professor (1979); MS, Naval Postgraduate School, 1984.

John E. Dawson, Professor (1966); PhD, Syracuse University, 1971.

Peter Carl Fredericksen, Professor (1974); PhD, Washington State University, 1974.

Stephen Frederick Hurst, Lieutenant Colonel, U.S. Marine Corps; Instructor (1989); MS, Naval Postgraduate School, 1985.

John E. Keller, Adjunct Professor (1990); BA, Harvard University, 1956.

Charles J. LaCivita, Associate Professor (1985); PhD, University of California at Santa Barbara, 1981.

Francois Melese, Associate Professor (1987); PhD, University of Louvain, Belgium, 1982.

James H. Morris, Associate Professor (1982); PhD, University of Oregon, 1976.

Robert T. Parrish, Lieutenant Commander, U.S. Navy; Instructor (1990); MA, Boston University, 1989.

Allan W. Poikonen, Major, U.S. Army; Instructor (1990); MA, Eastern Michigan University, 1987.

David V. Smith, Lieutenant Commander, U.S. Navy; Instructor (1989); MS, Naval Postgraduate School, 1983.

Robert von Pagenhardt, Professor (1967); PhD, Stanford University, 1970.

Kent D. Wall, Professor (1985); PhD, University of Minnesota, 1971.

Darnell M. Whitt, II, Associate Professor (1988); PhD, Johns Hopkins University, 1977.

EMERITUS FACULTY

William Ayers Campbell, Professor Emeritus (1970); MSIM, University of Pittsburgh Graduate School, 1949.

Frank Elmer Childs, Professor Emeritus (1965); PhD, University of Minnesota, 1956.

Norman Plotkin, Professor Emeritus (1969); PhD, Claremont Graduate School, 1969.

Ivon William Ulrey, Professor Emeritus (1966); PhD, Ohio State University, 1953.

Carlton Leroy Wood, Professor Emeritus (1966); PhD, Heidelberg University, 1936.

* The year of joining the Naval Postgraduate School faculty is indicated in parentheses.

DEFENSE RESOURCES MANAGEMENT EDUCATION CENTER

Established in 1965 as the Navy Management Systems Center and redesignated to its present title in July 1974, the Defense Resources Management Education Center is a jointly staffed U.S. Department of Defense sponsored educational institution located as a tenant activity at the Naval Postgraduate School. It conducts educational programs in resources management, both in residence at Monterey and on-site, for military officers and civilian defense officials of the U.S. and cooperating foreign nations. The focus of all programs conducted by the center is on the development of knowledge and improvement of understanding of the concepts, techniques and application of modern defense management, with specific emphasis on analytical decision making. The mission, objectives and responsibilities of the center are set forth in Department of Defense Directive 5010.35.

The center currently offers the following resident courses within its facilities at the Naval Postgraduate School:

DEFENSE RESOURCES MANAGEMENT COURSE -
Four weeks in length; presented five times per year.

INTERNATIONAL DEFENSE MANAGEMENT COURSE -
Eleven weeks in length; presented twice a year.

SENIOR INTERNATIONAL DEFENSE MANAGEMENT COURSE -
Four weeks in length; presented once each year (normally in the month of June).

Descriptions of these courses are provided on the following page; detailed information on current quota control agencies and procedures may be found in DOD Publication 5010.16-C (Defense Management Education and Training Catalog) or by calling DRMEC at: Commercial (408) 646-2104, Autovon 878-2104.

In addition to its regularly scheduled resident programs, the center also provides:

MOBILE EDUCATION COURSES - normally two or three weeks in length, for U.S. military services and defense agencies and for foreign governments upon specific request and approval.

COURSES FOR OTHER AGENCIES - programs are from two to four weeks duration, resident or on-site, for non-defense federal agencies and state and local governments, upon specific request and approval.

Faculty of the center are members of the faculty of the Naval Postgraduate School on assignment to the center.

Since 1966, over 17,000 officials, of whom more than 6,000 represented 82 foreign nations, have participated in programs conducted by the center.

DEFENSE RESOURCES MANAGEMENT COURSE

Military officers of all services, grades 0-4 and above, and civilian employees GS-11 and above, are eligible to attend this course. Also civilians in accelerated career development programs may attend.

The objective of this four-week course is to provide an appreciation of the concepts, principles and methods of defense management as they concern planning, programming, budgeting and related activities. Emphasis is placed on the analytical aspects of management, stemming from the disciplines of management systems, economics and quantitative analysis.

Participants are not expected to become experts or technicians in the various disciplines and subjects included in the curriculum. The objectives are to provide orientation on the overall functioning of the defense management process; insights as to what defense management requires in the way of inputs and analysis for decision making; understanding of the principles, methods and techniques used; and awareness of the interfaces between management requirements of the Defense Department components and the Office of the Secretary of Defense. Course methodology includes lectures, small group discussions reinforced by illustrative case studies and problem sets, as well as selected daily reading assignments.

This course is primarily for U.S. officials, although limited numbers of international participants are normally also enrolled.

INTERNATIONAL DEFENSE MANAGEMENT COURSE

The course is designed for participants in the military grades of 0-4 (Major/Lieutenant Commander) through 0-6 (Colonel/Captain) and defense-related civilians of equivalent rank. Enrollment is currently limited to a maximum of 48 participants. Broad national representation is desired for this course, i.e., participation of at least 10-15 nations enhances the value of the comparative management aspects of this curriculum.

The course is presented in English.

The course provides a series of lectures in three major areas: environmental factors, quantitative and economic analysis and management systems in the context of strategy, implementation and operations. The lectures are supplemented by small group discussions and workshops which concentrate on the lecture topics and associated readings, problems and cases. In the discussion groups, faculty members guide the interchange of ideas and are available to answer questions. Readings are assigned from within texts and supplemental material given to the participants to facilitate preparation for each lecture. Lecture outlines with additional suggested reading lists are provided. Occasional open seminar speakers are invited for special topics.

Throughout the course, the participants are encouraged to present and discuss information with respect to the defense management systems of their countries and to examine how the management concepts and techniques discussed by both the faculty and the participants from other countries may be applied in their own situations. Comparative study by means of interaction among participants is considered to be an extremely valuable characteristic of the course.

During the course, the center conducts a field trip to selected military and government agencies in the Washington, D.C. area. This trip provides an opportunity for the participants to receive special briefings on management techniques and problems and to observe actual practices at the operating level.

In the second half of the course, the general concepts of defense management are elaborated in detail during the examination of actual systems in financial, material and human resourses management. At the end of the course, a general review integrates the formal course material, special topics and field trip experiences.

SENIOR INTERNATIONAL DEFENSE MANAGEMENT COURSE

Enrollment is restricted to military flag and general officers (grades 0-7 and above) and defense-related civilians of equivalent rank, except that for countries where the 0-6 grade is comparable to flag/general rank such officials may be enrolled on a waiver basis.

Participation in this course is normally from 50 to 54 senior officials from as many as 26 countries.

The course is presented in English.

The lecture, small discussion group, case study and problem format and content described above for IDMC also apply, but are compressed in time. Two or three guest speakers are invited to address the class and a short field trip is conducted.

TENATIVE SCHEDULE OF RESIDENT COURSES
DEFENSE RESOURCES MANAGEMENT EDUCATION CENTER
FISCAL YEAR 1991

COURSE NAME	COURSE NUMBER	LENGTH (weeks)	DATES (inclusive)
International Defense Management Course*	IDMC 90-2	11	24 SEP - 06 DEC 1990
Defense Resources Management Course	DRMC 91-1	4	07 JAN - 01 FEB 1991
International Defense Management Course	IDMC 91-1	11	04 FEB - 17 APR 1991
Defense Resources Management Course	DRMC 91-2	4	22 APR - 16 MAY 1991
Defense Resources Management Course	DRMC 91-3	4	20 MAY - 14 JUN 1991
22nd Annual Senior International Defense Management Course	SIDMC 91	4	24 JUN - 19 JUL 1991
Defense Resources Management Course	DRMC 91-4	4	22 JUL - 15 AUG 1991
Defense Resources Management Course	DRMC 91-5	4	19 AUG - 13 SEP 1991
International Defense Management Course*	IDMC 91-2	11	23 SEP - 06 DEC 1991

* These courses convene in one fiscal year and continue into the next fiscal year.

APPENDIX A: DISTINGUISHED ALUMNI

Among those U.S. officers who have completed a curricular program at the Naval Postgraduate School, the following officers (USN unless otherwise indicated) have attained flag rank and were on the active list as of May 1990:

Admiral Jerome L. Johnson

Vice Admiral Stanley R. Arthur
Vice Admiral Roger F. Bacon
Vice Admiral James F. Dorsey, Jr.
Vice Admiral Richard C. Gentz
Vice Admiral Peter M. Hekman, Jr.
Vice Admiral Robert K. U. Kihune
Vice Admiral Henry H. Mauz, Jr.
Vice Admiral John W. Nyquist
Vice Admiral James G. Reynolds
Vice Admiral Jerry O. Tuttle

Rear Admiral John W. Adams
Rear Admiral Richard C. Allen
Brigadier General John C. Arick, USMC
Rear Admiral Don W. Baird
Rear Admiral James B. Best
Rear Admiral Thomas C. Betterton
Rear Admiral Larry E. Blose
Rear Admiral William C. Bowes
Rear Admiral Steven R. Briggs
Rear Admiral Dennis M. Brooks
Lieutenant General W. G. Carson, Jr., USMC
Rear Admiral John F. Calvert
Rear Admiral Arlington F. Campbell
Rear Admiral Kenneth L. Carlsen
Rear Admiral William C. Carlson
Rear Admiral Stephen K. Chadwick
Rear Admiral Ming E. Chang
Rear Admiral Philip J. Coady, Jr.
Rear Admiral Jon S. Coleman
Rear Admiral Michael C. Colley
Rear Admiral Dennis R. Conley
Rear Admiral Eugene D. Conner
Rear Admiral Walter J. Davis
Rear Admiral Joseph J. Dantone
Rear Admiral John J. Donegan, Jr.
Rear Admiral William A. Dougherty, Jr.
Rear Admiral Philip F. Duffy
Rear Admiral William A. Earner
Rear Admiral Donald R. Eaton
Rear Admiral Lawrence G. Elberfeld
Rear Admiral Thomas R. M. Emery
Rear Admiral James R. Fitzgerald
Rear Admiral R. D. Friichtenicht
Rear Admiral Salvatore F. Gallo
Rear Admiral George N. Gee
Rear Admiral W. Lewis Glenn, Jr.
Rear Admiral James B. Greene, Jr.
Rear Admiral Roland G. Guilbault
Major General Richard A. Gustafson, USMC
Rear Admiral William J. Hancock
Rear Admiral Robert G. Harrison
Rear Admiral Lowell J. Holloway
Rear Admiral John T. Hood
Brigadier General Joseph E. Hopkins, USA
Rear Admiral R. B. Horne, Jr.
Rear Admiral Douglas J. Katz

Rear Admiral Robert J. Kelly
Rear Admiral James E. Koehr
Rear Admiral James A. Lair
Rear Admiral Bobby C. Lee
Rear Admiral Irve C. Lemoyne
Rear Admiral John A. Lockard
Rear Admiral Stephen F. Loftus
Rear Admiral Thomas J. Lopez
Rear Admiral Richard C. Macke
Rear Admiral Kenneth C. Malley
Rear Admiral Daniel P. March
Rear Admiral Thomas T. Matteson, USCG
Rear Admiral Henry C. McKinney
Rear Admiral Eric A. McVadon, Jr.
Rear Admiral Thomas A. Meinicke
Rear Admiral George A. Meinig, Jr.
Rear Admiral Thomas A. Mercer
Rear Admiral Fredrick J. Metz
Rear Admiral James E. Miller
Rear Admiral Richard D. Milligan
Rear Admiral Riley D. Mixson
Brigadier General James M. Myatt, USMC
Rear Admiral Phillip R. Olson
Rear Admiral Paul W. Parcells
Rear Admiral Thomas D. Paulsen
Rear Admiral John D. Pearson
Rear Admiral James B. Perkins III
Rear Admiral Richard F. Pittenger
Rear Admiral Harry S. Quast
Rear Admiral Joseph P. Reason
Rear Admiral Daniel C. Richardson
Rear Admiral David N. Rogers
Rear Admiral Grant A. Sharp
Rear Admiral John F. Shaw
Brigadier General David V. Shuter, USMC
Brigadier General Stephen Silvasy, Jr., USA
Rear Admiral Robert J. Spane
Rear Admiral George R. Sterner
Rear Admiral Thomas E. Stone
Rear Admiral George H. Strohsahl, Jr.
Rear Admiral Robert Sutton
Rear Admiral Jeremy D. Taylor
Rear Admiral James E. Taylor
Rear Admiral William E. Terry
Rear Admiral Ralph L. Tindal
Rear Admiral Paul E. Tobin
Rear Admiral Robert L. Topping
Rear Admiral Robert E. Traister
Rear Admiral Jerry L. Unruh
Rear Admiral Richard C. Ustick
Rear Admiral William L. Vincent
Rear Admiral Douglas Volgenau
Rear Admiral Joseph S. Walker
Rear Admiral Raymond M. Walsh
Rear Admiral John C. Weaver
Rear Admiral Hugh L. Webster
Rear Admiral Ronald C. Wilgenbusch
Rear Admiral Richard A. Wilson
Rear Admiral Hugh D. Wisely
Rear Admiral Ray C. Witter
Rear Admiral Daniel J. Wolkensdorfer
Rear Admiral Timothy W. Wright
Lieutenant General John J. Yeosock, USA

APPENDIX B: AWARDS FOR GRADUATES

ADMINISTRATIVE SCIENCES FACULTY AWARD FOR EXCELLENCE IN MANAGEMENT
Presented semiannually to an outstanding student in Administrative Sciences at the Naval Postgraduate School in recognition of distinguished academic achievement.

ADMIRAL WILLIAM ADGER MOFFETT AWARD
This award is presented annually to an outstanding graduate of the Aeronautical Engineering program on the basis of academic excellence, including thesis and career potential.

ARMED FORCES COMMUNICATIONS AND ELECTRONICS ASSOCIATION HONOR AWARD
Presented to that officer graduate who has achieved academic excellence and best demonstrated professional qualities in one of the following programs: Electronics, Communications, Intelligence, Command and Control, or Computer Technology.

ARMY CHIEF OF STAFF AWARD FOR EXCELLENCE IN OPERATIONS RESEARCH
Presented semiannually to a U.S. Army Officer student in the Operations Analysis program who possesses an outstanding academic record, including thesis and project work, and who demonstrates qualities indicative of an outstanding military officer.

ASTRONAUT MICHAEL J. SMITH, CAPT, USN, ASTRONAUTICS AWARD
Astronaut and CAPT Michael J. Smith, who was an alumnus of NPS, gave his life exploring space for the enrichment of mankind. This award is presented annually to an outstanding graduate of the Space Systems Engineering or Space Systems Operations curricula. The award is made on the basis of the student's academic excellence, including thesis, and his career potential.

CAPTAIN JOHN C. WOELFEL AWARD
Presented each June to the outstanding Naval Engineering program officer student on the basis of academic and leadership qualities and performance. Officers from the past September, December, March and June graduation classes are considered.

CHIEF OF NAVAL OPERATIONS ANTISUBMARINE WARFARE AWARD
Sponsored by the National Security Industrial Association and presented in recognition of distinguished academic achievement to that Antisubmarine Warfare curriculum graduate who has demonstrated outstanding academic performance and exhibited those qualities indicative of an outstanding military officer.

CHIEF OF NAVAL OPERATIONS AWARD FOR EXCELLENCE IN MANPOWER, PERSONNEL AND TRAINING ANALYSIS
This award is given semiannually to U.S. Navy, or Op-01 sponsored civilian, graduate of the Manpower, Personnel and Training Analysis curriculum who has demonstrated outstanding academic performance, thesis quality and leadership potential.

CHIEF OF NAVAL OPERATIONS AWARD FOR EXCELLENCE IN OPERATIONS RESEARCH
Presented semiannually to the outstanding USN or USMC graduate of the Operations Research program on the basis of academic achievement, experience tour performance, thesis work and demonstration of those qualities indicative of the outstanding military officer.

CHIEF OF NAVAL OPERATIONS COMMUNICATIONS AWARD

Presented in recognition of distinguished academic achievement in the Communications Engineering or Telecommunications Systems programs to that graduate who has attained an outstanding academic record and who exhibits those qualities of an outstanding military officer.

DEPARTMENT OF THE NAVY AWARD FOR ACADEMIC EXCELLENCE IN FINANCIAL MANAGEMENT

This award is presented semiannually to a financial management student who demonstrates overall academic performance, academic excellence in financial management courses, high leadership potential, future ability to contribute to professional, academic and public forums while meeting the highest standards of stewardship of the national trust, and thesis excellence.

JOINT CHIEFS OF STAFF COMMAND, CONTROL AND COMMUNICATIONS AWARD

Presented to the outstanding graduate of the Command, Control and Communications program in recognition of distinguished academic achievement based upon grades obtained, quality of thesis and overall performance.

MEWBORN STUDENT RESEARCH AWARD

Presented annually to an officer student whose thesis exhibits sound scholarship and highest research ability. Criteria of selection conform as nearly as possible to the concept of "evidence of research potential" which forms the basis for election to Associate Membership in the Society of Sigma Xi.

MILITARY OPERATIONS RESEARCH SOCIETY GRADUATE RESEARCH AWARD

Presented in recognition of outstanding achievement in graduate research directed toward improving military force utilization. The primary award criterion is research which leads to demonstration of, or potential for, increased operating effectiveness of currently available or near term assets.

MONTEREY KIWANIS CLUB OUTSTANDING FOREIGN STUDENT AWARD

Presented annually, this award is based on criteria provided by the Kiwanis Club of Monterey including the following; academic standing and achievements, involvement in community affairs, motivation, demeanor and appearance, and relationship with other students.

MONTEREY PENINSULA COUNCIL NAVY LEAGUE AWARD FOR HIGHEST ACADEMIC ACHIEVEMENT

The award is presented quarterly to the graduation USN, USMC, USCG or NOAA student who has maintained an outstanding overall academic record at the Naval Postgraduate School. Excellent academic achievement, thesis research, military bearing, motivation and community involvement are the criteria for selection.

THE NAVAL POSTGRADUATE SCHOOL SUPERIOR SERVICE AWARD

This award is presented intermittently for outstanding service which would have a lasting impact on the student community and the school. The award is based on leadership, organizational abilities and the nominee should have in some way improved the life of students and the community.

NAVAL SEA SYSTEMS COMMAND AWARD FOR EXCELLENCE IN UNDERSEA WARFARE TECHNOLOGY
This award is presented annually at the March graduation ceremony to an outstanding officer student who successfully completes any curricular program and a thesis which demonstrates outstanding potential for application to Underseas Warfare Technology.

NAVAL SEA SYSTEMS COMMAND AWARD FOR WEAPON SYSTEMS ENGINEERING EXCELLENCE
Presented in recognition of distinguished scholastic achievement in a Weapons Engineering field of study. Selection is based upon marks attained, quality and applicability of thesis, and demonstrated leadership potential in the field of Weapons Engineering.

NAVAL SEA SYSTEMS COMMAND AWARD IN ELECTRONIC WARFARE TECHNOLOGY
Presented in recognition of academic achievement in the Electronic Warfare Systems Technology program to that graduate who has attained an outstanding academic record and who has exhibited outstanding leadership qualities.

NAVAL SEA SYSTEMS COMMAND AWARD IN NAVAL ENGINEERING
Presented in recognition of distinguished academic achievement in the Naval Engineering Program. The criteria for the award include: demonstrated academic excellence measured by marks attained, content of thesis and demonstrated leadership potential in Naval Engineering.

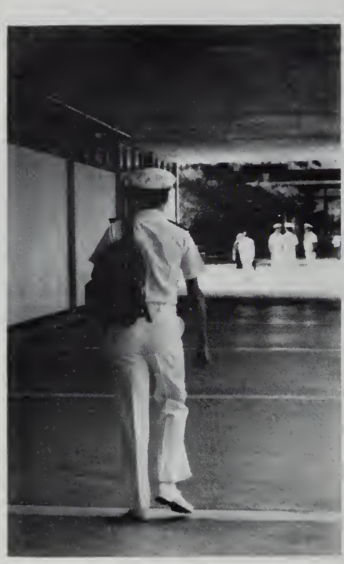
NAVAL SUPPLY SYSTEMS COMMAND AWARD FOR ACADEMIC EXCELLENCE IN ADMINISTRATIVE SCIENCES
Presented semiannually to an outstanding U.S. Navy Supply Corps officer in Administrative Sciences. This award is made on the basis of academic achievement, research excellence, contribution to the professional and civilian community, and faculty recommendation.

NAVAL SURFACE WEAPONS CENTER AWARD FOR EXCELLENCE IN SURFACE WARFARE TECHNOLOGY
Presented semiannually to a U.S. Naval officer of high academic standing whose thesis topic and quality of supporting research demonstrates the greatest potential for contribution to surface warfare.

NAVAL UNDERWATER SYSTEMS CENTER AWARD FOR EXCELLENCE IN UNDERWATER SYSTEMS TECHNOLOGY
Presented annually to the student, who by academic standing and relevance of thesis topic, has demonstrated the greatest achievement in the field of Underwater Systems Technology.

OCEANOGRAPHER OF THE NAVY AIR-OCEAN SCIENCES AWARD
Presented to a U.S. Naval Officer graduate of the Air-Ocean Sciences program who has demonstrated outstanding performance and exhibited those qualities indicative of an outstanding military officer.

THE OUTSTANDING ACADEMIC ACHIEVEMENT AWARD FOR DEPARTMENT OF DEFENSE STUDENTS
Presented quarterly to the graduating USA, USAF or DOD civilian student who has maintained an outstanding academic record at the Naval Postgraduate School based on the same criteria as the Navy League Award.



THE OUTSTANDING ACADEMIC ACHIEVEMENT AWARD FOR INTERNATIONAL STUDENTS

This award is presented quarterly on the basis of outstanding achievement in the areas of academic achievement, thesis research, military bearing, motivation, community involvement and relationship with other students.

REAR ADMIRAL GRACE MURRAY HOPPER AWARD FOR COMPUTER TECHNOLOGY

Presented to a graduating USN, USMC or USCG officer on the basis of thesis quality, academic performance and demonstrated leadership ability in the study of computer technology.

REAR ADMIRAL THOMAS R. MCCLELLAN AWARD FOR ACADEMIC EXCELLENCE IN ADMINISTRATIVE SCIENCES

Presented to a graduate of Administrative Sciences from the aviation community, based upon academic performance, professional commitment and leadership potential.

SPACE AND NAVAL WARFARE SYSTEMS COMMAND AWARD IN ELECTRONICS SYSTEMS ENGINEERING

Presented semiannually to a U.S. Naval Officer Student in recognition of distinguished academic achievement in the advanced Electronics Engineering program.

THE SPACE AND NAVAL WARFARE SYSTEMS COMMAND AWARD IN ELECTRONIC WARFARE TECHNOLOGY

Presented in September to the Naval Postgraduate School student graduating in the Electronic Warfare Systems Technology curriculum who possesses an outstanding academic record, including thesis work, and exhibits outstanding leadership qualities.

THE SPACE SYSTEMS ENGINEERING AWARD FOR ACADEMIC EXCELLENCE

Presented annually to an outstanding student in Space Systems Engineering program in recognition of distinguished academic achievement based upon grades obtained, quality of thesis and overall performance.

THE SPACE SYSTEMS OPERATIONS AWARD FOR ACADEMIC EXCELLENCE

Presented annually to an outstanding student in the Space Systems Operations program in recognition of distinguished academic achievement based upon grades obtained, quality of thesis and overall performance.

UNITED STATES NAVAL INSTITUTE AWARD

Presented each quarter to that recipient of a master's degree in National Security Affairs whose achievement has significantly advanced professional, literary or scientific knowledge in the naval or maritime services.

WARREN RANDOLPH CHURCH AWARD

Presented annually to an officer student for outstanding performance in mathematics. The criteria for selection include evidence of initiative, scholarly attitude and mathematical maturity.

APPENDIX C: AWARDS FOR FACULTY

THE CARL E. AND JESSE W. MENNEKEN ANNUAL FACULTY AWARD FOR EXCELLENCE IN SCIENTIFIC RESEARCH

Mrs. Jesse W. Menneken has provided the NPS Foundation with an annual award of $2000.00 to be presented to an NPS faculty member who has exhibited outstanding research efforts in science or engineering. Presented annually at the December graduation if suitable candidates are nominated.

CARL E. MENNEKEN RESEARCH AWARD

Awarded at the Spring initiation meeting of Sigma Xi and acknowledged at the June commencement exercises, this award is based on distinguished research contributions.

DISTINGUISHED PROFESSOR AWARD

Presented to a faculty member who has merited recognition for his or her scholarly accomplishments and lasting educational contributions to the school. The recipient of this award joins a select group of faculty bearing the title of Distinguished Professor.

REAR ADMIRAL JOHN JAY SCHIEFFELIN AWARD FOR EXCELLENCE IN TEACHING

This award is made annually to recognize faculty members, who, through wide consensus, excel as teachers. This consensus is ascertained through a ballot polling of students and graduates.

THE HISTORY OF NPS

The proud history of the Naval Postgraduate School dates back to the early 1900's. On June 9, 1909, shortly after the completion of the record-setting world cruise of Teddy Roosevelt's Great White Fleet, the Secretary of the Navy signed General Order No. 27, establishing a school of marine engineering at Annapolis, Maryland.

The first program consisted of only ten officer students who attended propulsion classes taught by two Navy instructors in an attic at the Naval Academy. Three years later, the program was expanded to include courses in ordinance and gunnery, electrical engineering, radio telegraphy, naval construction and civil engineering. With the additional curricula, enrollment increased to 25. In the 1920's the program was again reorganized— more new curricula were added, including aerological and aeronautical engineering, and the first interservice and international officers were accepted.

During World War II, the Pye Commission was established to review the role of graduate education in the Navy. Based on the commission's findings, Congress passed legislation to make the Naval Postgraduate School a fully accredited, degree-granting graduate institution in 1945. Two years later, the Navy purchased the Hotel Del Monte in Monterey, California, along with 627 surrounding acres of land, for $2.5 million. In 1951, the school, which consisted of 500 students and 100 faculty and staff members, moved from Annapolis to Monterey. Here the school flourished, and enrollment grew to its current level of just under 2,000 students.

Through the years, the facilities have been expanded and enhanced to provide students and faculty with state-of-the-art laboratories and resources— but the classic grandeur of the site that once catered to wealthy socialites, sport stars and film celebrities remains.

The Hotel Del Monte, built by San Francisco's "big four" railroad tycoons, opened its doors on June 10, 1880. The hotel was billed as "the most elegant seaside establishment in the world". During the era of opulence and luxury before the world wars, the "grand dame of America" transformed Monterey into a social mecca for the wealthy. Guests travelled by train from San Francisco to indulge in such luxuries as telephones in every room and both hot and cold running water.

The Del Monte also provided many innovative recreational activities for guests to enjoy. Golf was introduced to the Monterey Peninsula (and California) when the hotel built the first course in 1897. (That course is still in use today.) A horse racing track, polo field and a special dirt course for the newly emerging automobile were other novel facilities built for the pleasure of guests. In addition, patrons could enjoy tennis, croquet, archery, skeet shooting, the world's largest bathing pavilion and beautifully sculptured gardens.

Within seven years of its opening the hotel was receiving an annual 17,000 visitors, far more than the population of Monterey. It was at this peak when tragedy struck. An 1887 fire completely destroyed the world-class resort. While it was quickly resurrected, reopening in 1888, the hotel enjoyed only a few more years of popularity before interest started to wane.

Samuel F. B. Morse, grandson of the inventor, took over as manager of the ailing hotel in 1919. In an effort to revive the splendor that had once existed, Morse introduced numerous changes, including a relaxed dress code and late night orchestra entertainment.

The changes worked. Within a year the hotel was the "in" spot again. The 1920's brought film and sport stars and the who's who crowd of California to the Hotel Del Monte. Greer Garson, Clark Gable and Charlie Chaplin were among the guests who frequented the resort.

The success was short lived, however. On October 29, 1924, an early morning fire threatened to demolish the hotel again. By dynamiting the ballroom, the two wings of the hotel were saved, but the main building was destroyed.

Reconstructed by 1926, the new hotel differed from the previous two— it was made of concrete. But, while the hotel was built to withstand fire, it could not withstand the Great Depression or World War II. The lavish spending of years past were gone and the Hotel Del Monte was forced to close its doors.

After its closure, the hotel was first leased to the Navy for use as a pre-flight training school; then in 1947 it became the permanent home of the Naval Postgraduate School.

From its humble beginning of ten students in two attic rooms at the Naval Academy to the near 2,000 students at the spectacular facilities of the Hotel Del Monte, the Naval Postgraduate School has become one of the nation's foremost institutions of higher education.

THE MONTEREY PENINSULA

Located on the Monterey Bay, 120 miles south of San Francisco, the city of Monterey and the surrounding area offer officer students and their families a spectacular environment in which to live. From the beautiful scenery to the multitude of attractions and activities, the Monterey Peninsula has something for everyone.

Within walking distance of the school, students can enjoy historic downtown Monterey, Fisherman's Wharf or Cannery Row, made famous by John Steinbeck. In addition to numerous shops and restaurants, each of these attractions tells of Monterey's interesting history in a manner that both young and old can appreciate.

Cannery Row is also home to the world famous Monterey Bay Aquarium. Featuring more than 5,500 sea creatures, visitors can watch animals such as sea otters, sharks, wolf eels and octopus eat, swim and play in an environment built to closely parallel their natural habitat. Through an array of exhibits, the aquarium offers an excellent learning center for people of all ages.

To the south of Monterey lies the quaint town of Camel-By-The-Sea. Art galleries, restaurants and specialty shops line the streets that lead to white sandy beaches. The popularity of this town, whose mayor was Clint Eastwood from 1986 to 1988, is world-wide— tourists from all over come to vacation in Carmel.

Continuing south, sightseers can enjoy spectacular Pacific coastline scenery along the winding roads to Big Sur. Featuring redwood forests, waterfalls and rustic beaches, Big Sur is a great place for hiking and camping.

At the other end of Monterey Bay lies Santa Cruz— a typical California beach town. Known for its warmer weather, Santa Cruz is famous for its sandy beaches, great surfing and a beach-front amusement park, complete with a wooden roller coaster.

The Monterey Peninsula is also known for its community activities, which help prove that, while the area has grown in population, much of the small-town atmosphere remains. There are parades, festivals, regattas, salmon derbies, arts and crafts exhibits and fairs. Rarely a weekend goes by without some community festivity to enjoy.

Living on the Monterey Peninsula is exciting. The area offers as much in the way of recreation for the whole family as it does in natural beauty. The historic buildings, numerous parks, forests and beaches, and an abundant list of other attractions, are waiting to be explored.

FAMILY LIFE

The Naval Postgraduate School provides military officers with the opportunity to live with their families for an extended period of time. With spectacular places to visit on family outings, an excellent school system and a growing job market— spouses and children adjust easily to life on the Monterey Peninsula. It is here that the family can flourish. The facilities at NPS and in the community help make living on the Monterey Peninsula a positive experience for the entire family.

Naval Postgraduate School families with children ranging in age from newborn to 12 years have a variety of child care options available to them. Parents can choose from programs available at NPS, Fort Ord, the Defense Language Institute and La Mesa government housing complex, as well as in the community at large. The Family Service Center provides up-to-date information about different child care options and will help parents find the best program for their children.

School-age children attend one of the 24 schools in the Monterey Peninsula Unified School District or can choose to study at a private institution. The majority of students attend La Mesa Elementary School, located in the housing complex. The school systems, both public and private, are rated among the best— students receive a top-notch education.

Based on the California Test of Basic Skills, students on the peninsula continually rank at or above average in reading, math and written expression when compared to other California students. Nationwide, students also do very well— their Scholastic Aptitude Test (SAT) scores are above the national averages in both math and verbal skills.

Students are taught basic and advanced skills in reading, language arts, writing and math through a sequenced program. The curricula of the public schools also includes courses in music, computers, science, foreign language and library skills.

The staff and faculty at schools around the peninsula are familiar with the special needs of military dependents and will help students adjust to their new school. A wide range of special programs and extra-curricular activities are available.

For those seeking additional credits and degrees through higher education, there are a variety of college programs from which to choose. Bachelor's and master's degrees can be earned from one of four area universities— Chapman College, Golden Gate University, University of California at Santa Cruz and the California State University at San Jose. For convenience, each of these schools offers classes in the Monterey/Salinas area through branch offices and extension programs.

Monterey Peninsula College (MPC) provides another option for students interested in pursuing an associate in arts or science degree which can be transferred to a four-year institution. MPC, a California Community College, also offers programs in many vocational fields such as nursing, data processing, electronics and office occupations.

For spouses seeking employment on the Monterey Peninsula, the Family Service Center provides lists of private sector and civil service vacancies including full-time, part-time and temporary jobs. The center also offers information on resume development, tips on interviewing and help in completing employment applications. The objectives of the employment programs at NPS are to help mobile spouses maintain career continuity through the relocation process.

The job market on the peninsula presents many options to spouses. A sampling from almost every career path can be found. Some of the

After eight years at sea, **Lieutenant Commander Kevin P. Denham** came ashore to pursue his Masters in Applied Science at the Naval Postgraduate School. And, although anxious to go back to sea, Denham is glad he came to the peninsula.

"NPS has given me the technical background necessary to understand and analyze problems when they arise, it's given me an added appreciation for how the aquisition process works, and helped me to understand the technical aspects of the systems I'll be operating in the future," says Denham.

His research, entitled "Evaluation of an Acoustic Signal Tracking Process for Passive Sonar Systems," examines automatic tracking programs for acoustic signatures of submarines. He'll be able to put his new-found knowledge from this research and his studies at NPS to work on his next tour with the cruiser/destroyer group in Norfolk, Virginia.

Denham's main regret about leaving NPS and Monterey pertains to his family. He and he wife, Donna, both feel the schooling available to their kids, Meghan and Scott, is "super," and the area as a whole is a "terrific place to raise children."

ore prominent industries on the peninsula include hospitality, high-ch, publishing, retail, financial and health care. Monterey may not fer the unlimited job options found in big cities, but there are umerous opportunities available, specially for people who actively search e job market.

he Monterey Peninsula is a great place to ise a family. Here, in the midst of eautiful surroundings, officers will find e day care facilities, school systems and b opportunities necessary for the evelopment of their whole family. epending on their master's program, ficers will spend either two or three ears at the Naval Postgraduate School. uring this time, they can enjoy watching eir families grow while actively taking art in the experience. Both officers and eir families will reap the benefits of eing together.

HOUSING

While living on the Monterey Peninsula has its many advantages, there is a price that must be paid— and that price comes in the form of housing costs. The housing market in Monterey is comparable to other popular areas with mild, coastline climates and spectacular scenery; it is expensive. Officers will have to pay more for less on the peninsula. But, the Naval Postgraduate School helps to make relocating to the area a positive experience by providing government housing for many officers and assistance in finding community housing for others. The options available to officer students and their families are numerous, allowing them to choose the best home to fit their needs.

Half of NPS student families live in the 877-unit La Mesa government housing complex. La Mesa is a self-contained village located about one and one-half miles from the Naval Postgraduate School campus. A store, beauty salon, six tennis courts, little league fields, numerous playgrounds and a public elementary school are located within the complex. For convenience, the elementary school is on a schedule that conforms with that of NPS.

Commander George Zolla has been in the Navy for 19 years and was considering several options including retirement, when he was given the opportunity to come to the Naval Postgraduate School. “It was a difficult decision for me. There were several good options— but NPS was just too good of an opportunity to pass up. I am happy with my choice, I think the education I am receiving here will make me more competitive for future promotions and job assignments.”

Zolla is working toward his Master of Science in Computer Systems Management, a field that he feels will play a vital role in the Navy's future. “There is a vast amount of information that can be found in the Navy's data bases around the world, tying together those data bases and managing the extraction of important information in a useful manner will be very important to the Navy's efficiency in the future.”

Zolla's wife Cheryl and their two children, Christine (age 12) and Shawn (age 7), have adjusted quickly to life on the Monterey Peninsula. Zolla says,“The government housing here is the best we've ever lived in, and we are very happy with the public school. Coming here has been an easy transition.”

La Mesa offers 34 floor plans with designs ranging from two-story townhouses to single family homes with fireplaces, to quadraplexes and duplexes. The village features four housing areas— Wherry Housing, Capehart Housing and two separate Funded Townhouse areas. Living space within these homes ranges from 811 to 1,622 square-feet with varying amounts of yard space.

Students who choose to live in the community, whether buying or renting a home, should be prepared to spend some time exploring the market before making a decision. Prices vary considerably between areas— and there is always a good deal waiting to be found.

Rent in Seaside, Marina and Salinas will generally be less than that of other areas on the Monterey Peninsula, with Monterey, Carmel and Pacific Grove representing the high side of this equation. Renters should expect to pay approximately $550 or more for a one-bedroom apartment and $750 to $800 for a two-bedroom residence. Three- and four-bedroom places are appreciably higher. The Family Service Center will provide officers with lists of short- and long-term housing available in the area.

Prospective buyers can also expect to find prices higher than at their previous duty stations. Officers are encouraged to actively search the area before making a purchase— prices fluctuate dramatically around the peninsula, and even considerably within the same town. Based on 1990 figures, median selling prices for housing around the Monterey Peninsula are: Carmel, $405,000; Pacific Grove, $263,000; Monterey, $252,000; Marina, $183,000; Salinas, $161,000; and Seaside, $150,000.

The facilities and relocation services that the Naval Postgraduate School provides are excellent. Whether officers choose to live in government housing or in the community, NPS is there to help make the move as easy as possible.

FACILITIES

Officer students and their families enjoy many privileges through the Naval Postgraduate School, Fort Ord and the Defense Language Institute. These three sites provide military personnel and their dependents on the Monterey Peninsula with resources ranging from health care to banking to shopping.

Military health care on the peninsula is provided primarily through two PRIMUS (Primary Care for the Uniformed Services) clinics located in Salinas and on the Presidio in Monterey. NPS students and their dependents can visit these clinics to receive physical exams, laboratory services, x-rays and treatment for illnesses and injuries.

The Silas B. Hays Army Hospital, located six miles from NPS on the Fort Ord base, provides emergency medical treatment and in-patient hospital care. The eight floor hospital is divided into 27 specialties such as allergies, nutrition, dermatology, radiology, neurology and optometry. A pharmacy is also available at the hospital.

Dental care is conveniently available to officers and their families at the NPS Dental Clinic located on the fourth floor of the Herrmann Hall.

NPS also offers banking services. Two credit unions are located in the basement of the administration building— the Monterey Federal Credit Union and the Navy Federal Credit Union. Each provides checking and savings accounts services, ATM's and a full range of loans. Officers and their families can choose to bank with either of these credit unions or with any of the other 23 banks on the peninsula.

The Naval Postgraduate School also offers students numerous shopping privileges. The Navy Exchange has a variety of stores and services on station ranging from dry cleaning to a full-service gas station and garage. The Army/Air Force Exchange Systems at Fort Ord and the Presidio provide similar services. Fort Ord also houses a large commissary for all active duty and retired military personnel.

The facilities at the Naval Postgraduate School are first-rate. Complemented by the privileges available at Fort Ord and the Defense Language Institute, NPS provides students with access to a full range of resources.

RECREATION

The Monterey Peninsula and NPS offer students and their families a gold mine of activities. No matter what their interests are, from athletic to musical, from physically challenging to relaxing, officers and dependents are sure to find a variety of activities that suit their needs.

The peninsula is famous for its golf courses. Pebble Beach, Spanish Bay, Spyglass and Cypress Point hug the rocky, sparkling Pacific shore, and offer some of the most spectacular scenery and challenging golf in the world. All told, there are over fifteen public and six private courses in the area.

The Naval Postgraduate School has its own 18-hole course that is open to active and retired military personnel, their dependents and guests. Private lessons are available by appointment, as are group lessons and youth programs.

Each year NPS holds a stroke-play golf tournament, the winner of which becomes an alternate in the annual AT&T Pro Am Golf Tournament at the Pebble Beach golf links. The Pro Am tournament, one of the biggest local events of the year, pairs amateur players, many of whom are celebrities, with professionals.

For those interested in sports outside of golf, the Naval Postgraduate School offers a wide variety of other recreational activities.

Officers who are qualified as cruising skippers can sail any of NPS's seven boats. The school owns four Shields Class sloops, one 22-foot Capris and two 22-foot Santanas. The NPS Recreation Department has regularly scheduled training programs open for those wishing to learn.

Team sports are also available at NPS. Around the campus and La Mesa there are four volleyball courts, two softball fields and one regulation size basketball court in the gymnasium. Interested parties can organize their own teams or contact the Recreation Department to find an existing team to join.

For the avid tennis player NPS offers 12 championship-quality courts. The courts can be found around the main campus and the NPS annex, and in the La Mesa Village. Tennis lessons are available through the Recreation Department. The department also sponsors a Tennis Association for officers and their families.

Swimmers can enjoy the pools located in front of Herrmann Hall which are open from May through October. Officers, dependents and guests are welcome to use the pools for lap swimming or leisure activities.

Other recreational options include the NPS gym which features three four-wall racquetball/handball courts, two squash courts, a basketball court and a fully equipped exercise room. The gym offers an extensive selection of athletic and camping equipment to eligible personnel for a nominal fee.

MONTEREY BAY SYMPHONY

For those looking for less physical activities, the military provides the NPS Officers and Faculty Club, which is known as one of the best in the Navy, and two theaters. The theaters, located at Fort Ord and the Defense Language Institute, show a variety of popular, newly released films during the week and on weekends.

In addition, there is a wide range of community events that occur throughout the year around the area. Laguna Seca Raceway offers Grand Prix “Indy car” automobile racing and the only Grand Prix Formula 1 motorcycle racing in the United States. The California International Airshow in nearby Salinas frequently features the Navy’s Blue Angels or the Air Force Thunderbirds. For those seeking both delicious locally grown foods and family oriented fun, there is the Monterey Squid Festival, the Gilroy Garlic Festival, the Castroville Artichoke Festival and the Watsonville Strawberry Festival. For music lovers, the Monterey Jazz Festival and Bach Festival are annual events. Sports fans are a two-hour drive away from the San Francisco 49ers, the Oakland A’s and the San Francisco Giants. Truly, the Monterey Peninsula offers something for everyone.

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ACADEMIC CALENDAR AY 1991

FALL QUARTER

Reporting Date	Monday, September 24, 1990
Instruction Begins	Monday, October 1, 1990
Columbus Day (Holiday)	Monday, October 8, 1990
Reporting Day for Refresher	Monday, November 5, 1990
Veteran's Day (Holiday)	Monday, November 12, 1990
Refresher Begins	Tuesday, November 13, 1990
Thanksgiving Day (Holiday)	Thursday, November 22, 1990
Final Examinations Begin	Monday, December 17, 1990
Graduation	Thursday, December 20, 1990
Christmas Break	Dec. 21, 1990 - Jan. 6, 1991

WINTER QUARTER

Reporting Date	Monday, December 31, 199
New Year's Day (Holiday)	Tuesday, January 1, 1991
Instruction Begins	Monday, January 7, 1991
Martin Luther King's Birthday (Holiday)	Monday, January 21, 1991
Reporting Date for Refresher	Monday, February 11, 1991
Washington's Birthday (Holiday)	Monday, February 18, 1991
Refresher Begins	Tuesday, February 19, 1991
Final Examinations Begin	Monday, March 25, 1991
Graduation	Thursday, March 28, 1991

SPRING QUARTER

Reporting Date	Monday, March 25, 1991
Instruction Begins	Monday, April 1, 1991
Reporting Date for Refresher	Monday, May 6, 1991
Refresher Begins	Monday, May 13, 1991
Memorial Day (Holiday)	Monday, May 27, 1991
Final Examinations Begin	Monday, June 17, 1991
Graduation	Thursday, June 20, 1991
Summer Break	June 21 - July 7, 1991

SUMMER QUARTER

Reporting Date	Monday, July 1, 1991
Independence Day (Holiday)	Thursday, July 4, 1991
Instruction Begins	Monday, July 8, 1991
Reporting Date for Refresher	Monday, August 12, 1991
Refresher Begins	Monday, August 19, 1991
Labor Day (Holiday)	Monday, September 2, 1991
Final Examinations Begin	Monday, September 23, 1991
Graduation	Thursday, September 26, 1991

ACADEMIC CALENDAR AY 1992

FALL QUARTER

Reporting Date	Monday, September 23, 1991
Instruction Begins	Monday, September 30, 1991
Columbus Day (Holiday)	Monday, October 14, 1991
Reporting Day for Refresher	Monday, November 4, 1991
Veteran's Day (Holiday)	Monday, November 11, 1991
Refresher Begins	Tuesday, November 12, 1991
Thanksgiving Day (Holiday)	Thursday, November 28, 1991
Final Examinations Begin	Monday, December 16, 1991
Graduation	Thursday, December 19, 1991
Christmas Break	Dec. 20, 1991 - Jan. 5, 1992

WINTER QUARTER

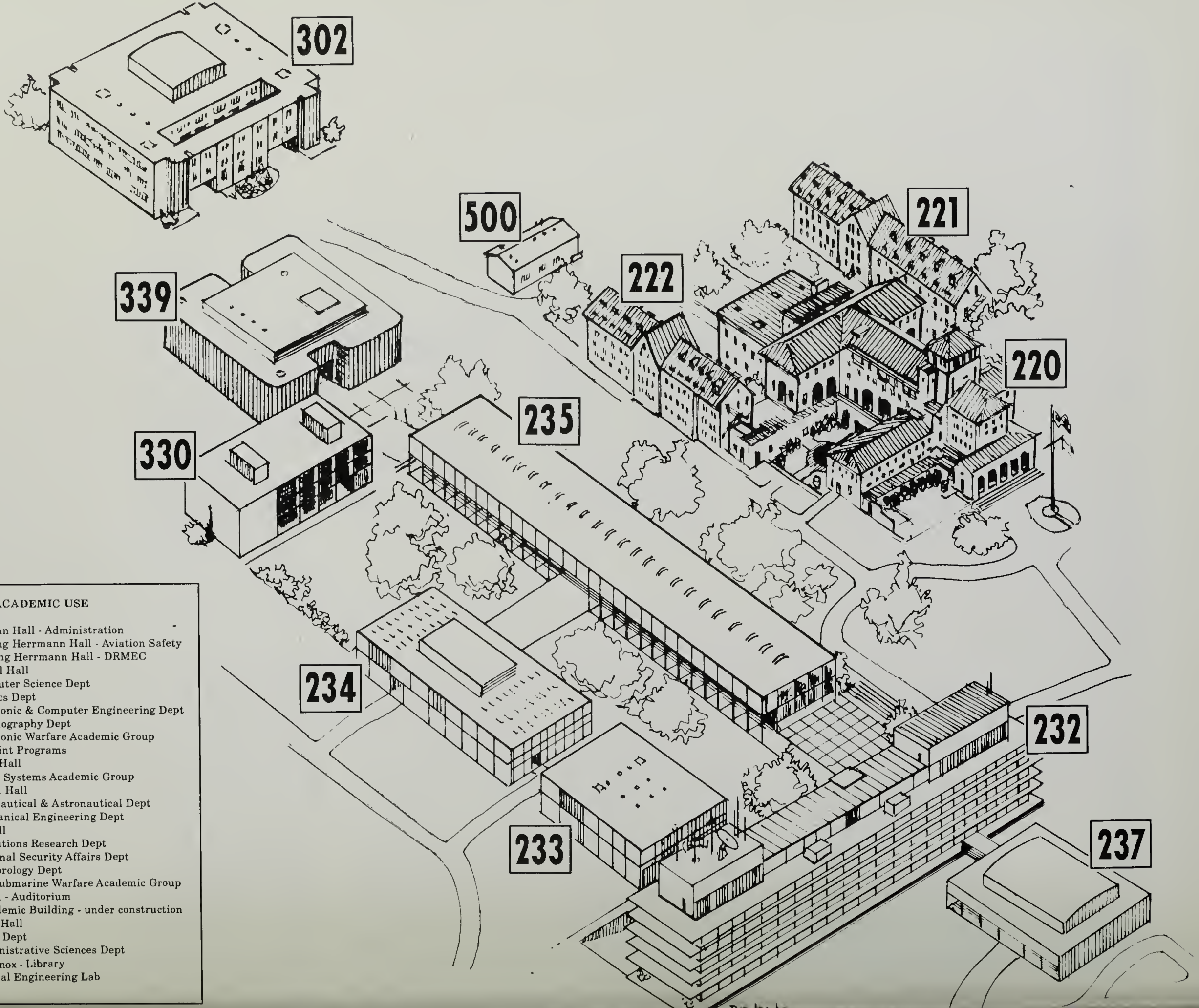
Reporting Date	Monday, December 30, 1991
New Year's Day (Holiday)	Wednesday, January 1, 1992
Instruction Begins	Monday, January 6, 1992
Martin Luther King's Birthday (Holiday)	Monday, January 20, 1992
Reporting Date for Refresher	Monday, February 10, 1992
Washington's Birthday (Holiday)	Monday, February 17, 1992
Refresher Begins	Tuesday, February 18, 1992
Final Examinations Begin	Monday, March 23, 1992
Graduation	Thursday, March 26, 1992

SPRING QUARTER

Reporting Date	Monday, March 23, 1992
Instruction Begins	Monday, March 30, 1992
Reporting Date for Refresher	Monday, May 4, 1992
Refresher Begins	Monday, May 11, 1992
Memorial Day (Holiday)	Monday, May 25, 1992
Final Examinations Begin	Monday, June 15, 1992
Graduation	Thursday, June 18, 1992
Summer Break	June 19 - July 5, 1992

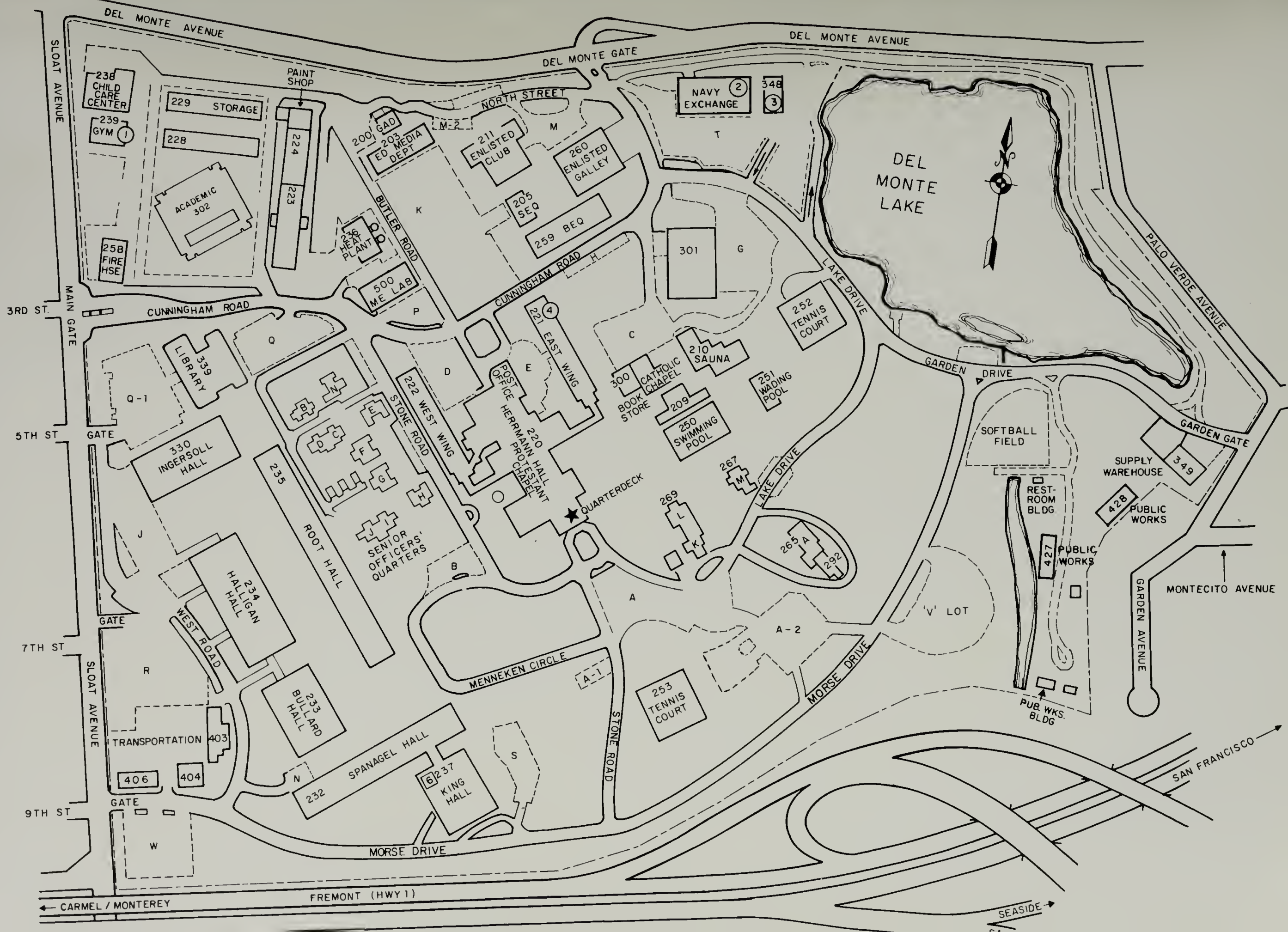
SUMMER QUARTER

Reporting Date	Monday, June 29, 1992
Independence Day (Holiday)	Friday, July 3, 1992
Instruction Begins	Monday, July 6, 1992
Reporting Date for Refresher	Monday, August 10, 1992
Refresher Begins	Monday, August 17, 1992
Labor Day (Holiday)	Monday, September 7, 1992
Final Examinations Begin	Monday, September 21, 1992
Graduation	Thursday, September 24, 1992



BLDG. #	NAME/ACADEMIC USE
220	Herrmann Hall - Administration
221	East Wing Herrmann Hall - Aviation Safety
222	West Wing Herrmann Hall - DRMEC
232	Spanagel Hall
	Computer Science Dept
	Physics Dept
	Electronic & Computer Engineering Dept
	Oceanography Dept
	Electronic Warfare Academic Group
	C3 Joint Programs
233	Bullard Hall
	Space Systems Academic Group
234	Halligan Hall
	Aeronautical & Astronautical Dept
	Mechanical Engineering Dept
235	Root Hall
	Operations Research Dept
	National Security Affairs Dept
	Meteorology Dept
	Antisubmarine Warfare Academic Group
237	King Hall - Auditorium
302	New Academic Building - under construction
330	Ingersoll Hall
	Math Dept
	Administrative Sciences Dept
339	Dudley Knox - Library
500	Mechanical Engineering Lab

① CAMPING GEAR ISSUE ② NAVY EXCHANGE ③ NAVY EXCHANGE SERVICE STATION ④ DISBURSING (E-113) HOUSEHOLD GOODS OFFICE (E-107-A)


DEL MONTE AVENUE
DEL MONTE GATE
DEL MONTE AVENUE
SLOAT AVENUE
238 CHILD CARE CENTER
239 GYM ①
229 STORAGE
228
ACADEMIC 302
25B FIRE HSE
PAINT SHOP
224
223
200 GAD
203 ED MEDIA DEPT
M-2
NORTH STREET
211 ENLISTED CLUB
M
260 ENLISTED GALLEY
NAVY EXCHANGE ②
348 ③
T
DEL MONTE LAKE
N
PALO VERDE AVENUE
K
236 HEAT PLANT
BUTLER ROAD
205 SEQ
259 BEQ
H
CUNNINGHAM ROAD
301
G
LAKE DRIVE
252 TENNIS COURT
500 ME LAB
P
3RD ST.
MAIN GATE
CUNNINGHAM ROAD
Q
339 LIBRARY
Q-1
221 EAST WING ④
D
E
POST OFFICE
C
300 BOOK STORE
CATHOLIC CHAPEL
210 SAUNA
251 WADING POOL
209
250 SWIMMING POOL
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222 WEST WING
STONE ROAD
220 HERRMANN HALL
PROTESTANT CHAPEL
QUARTERDECK
B
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D
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G
H
J
I
SENIOR OFFICERS' QUARTERS
267 M
LAKE DRIVE
269 L K
265 A
292
5TH ST
GATE
330 INGERSOLL HALL
235
ROOT HALL
B
J
234 HALLIGAN HALL
WEST ROAD
GATE
7TH ST
R
A
A-2
'V' LOT
A-1
MENNEKEN CIRCLE
STONE ROAD
253 TENNIS COURT
MORSE DRIVE
233 BULLARD HALL
SLOAT AVENUE
TRANSPORTATION
403
406
404
GATE
9TH ST
W
N
232
SPANAGEL HALL
6 237 KING HALL
S
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← CARMEL / MONTEREY
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